MACHINERY

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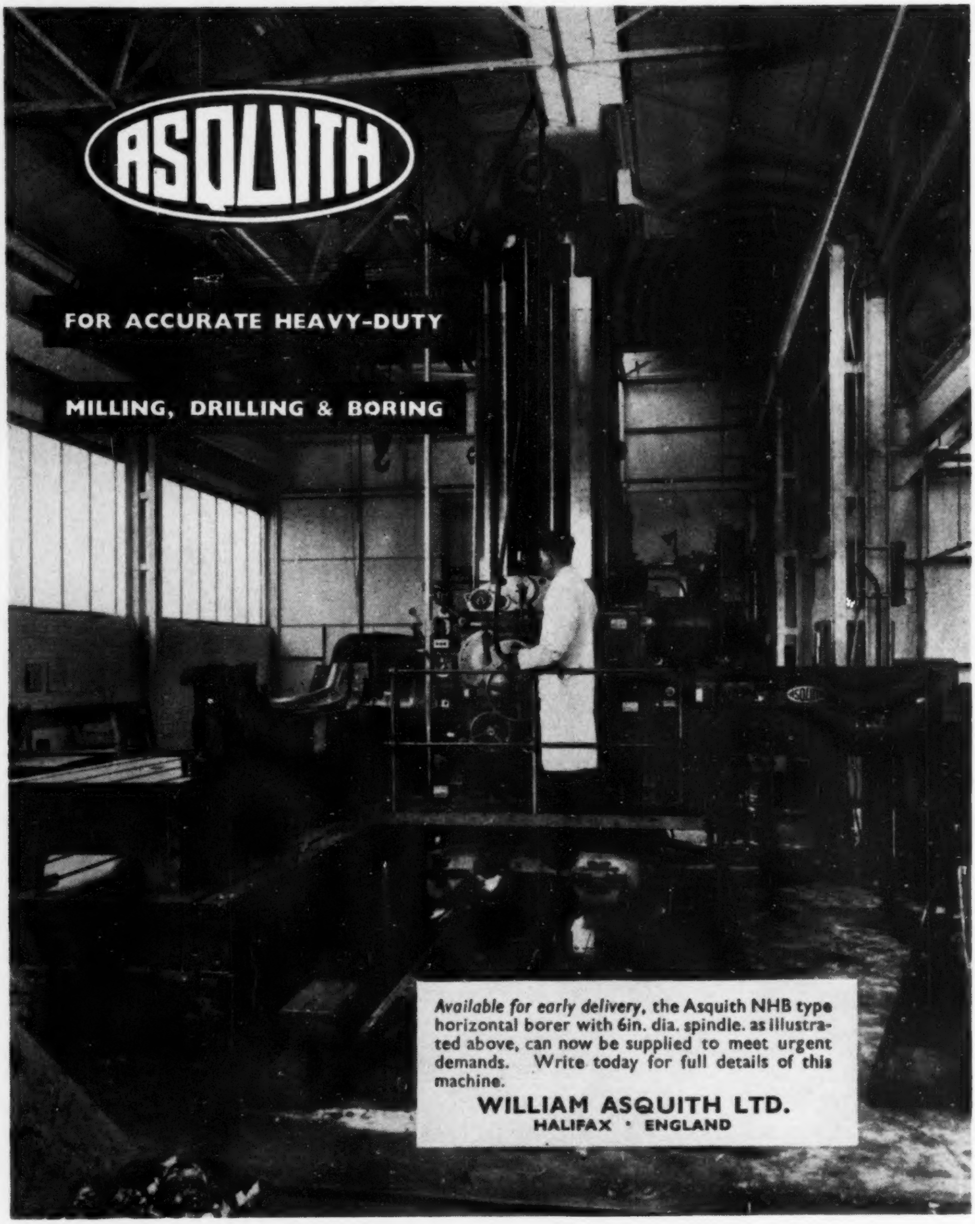

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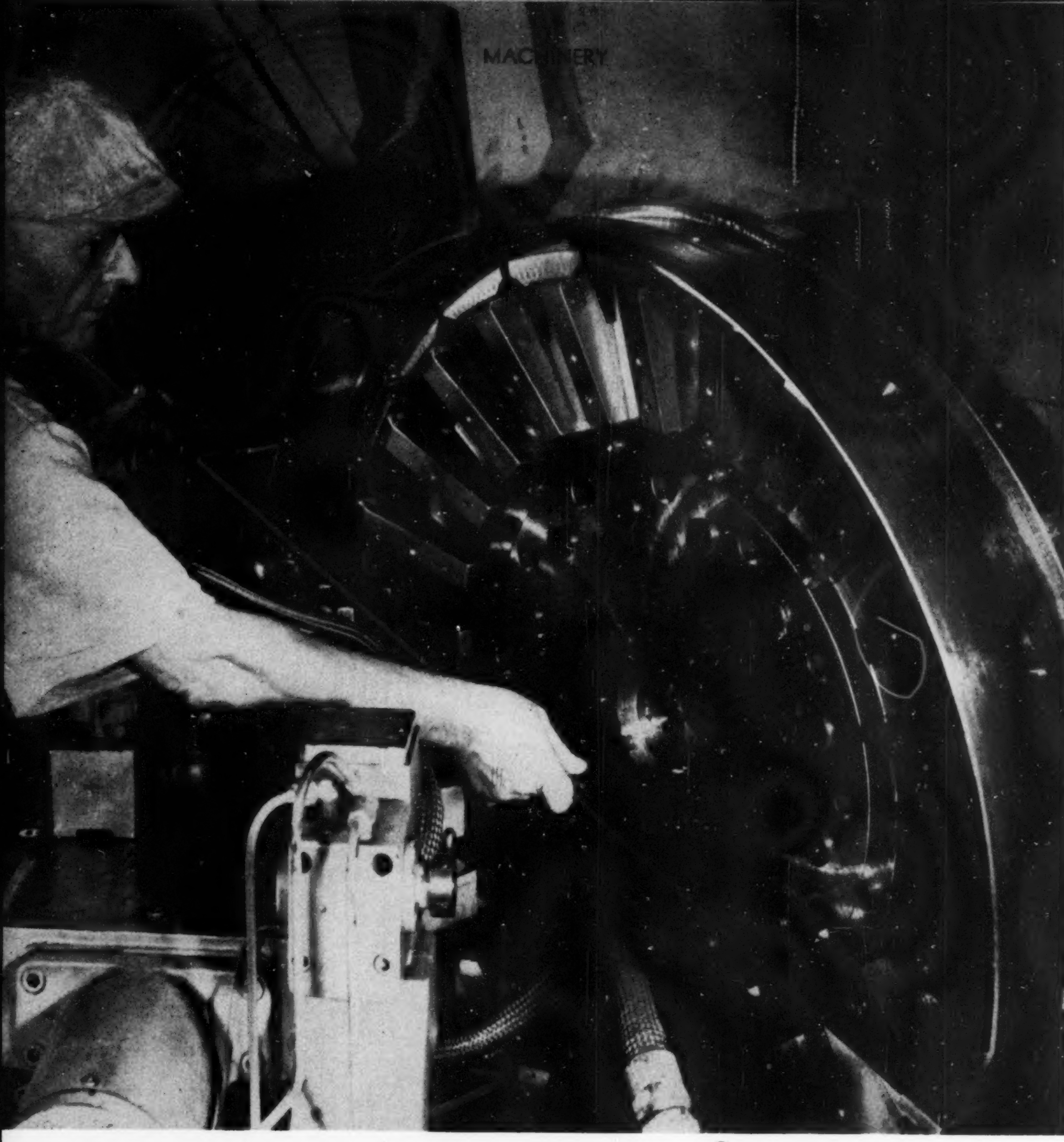

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LARGE AND THIN

The features of a Woodworth diaphragm chuck eliminate the locating problems on parts like the one shown.

Large thin walled jet parts require surrounding type jaws to avoid distortion from chucking pressure.

By completely filling the internal diameter of this part, the chucking action forces the part round. In this way uniform wall sections are obtained and accurate diameter and length dimensions can be machined.

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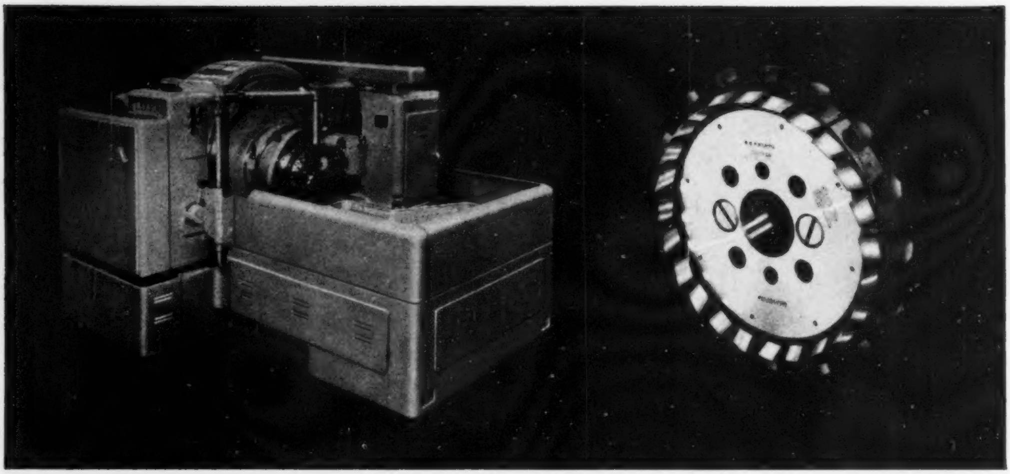
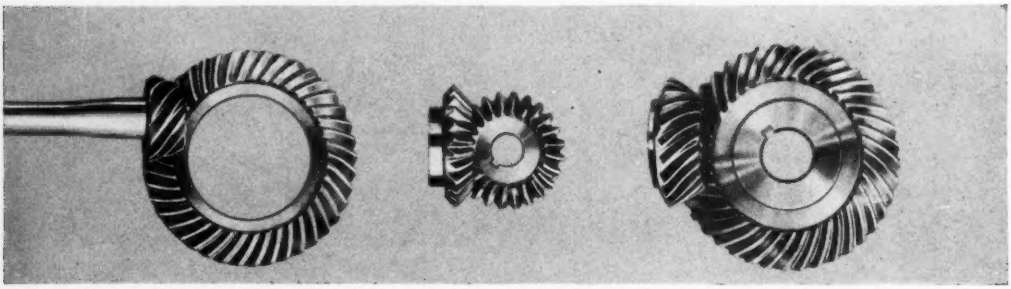


With one machine and one 'Unitool' cutter



you can produce all three types of gears

Now it takes only a relatively small capital investment to equip a shop for producing prototypes or small quantities of spiral, Zerol bevel and hypoid gears.

The new Unitool Method requires only one machine, the No. 116 Hypoid Generator shown above or the smaller No. 106, and one Unitool cutter to rough and finish both gears and pinions of a particular combination.

A total of six Unitool cutters cover gears and pinions of all designs from 1·3in. to 8in. cone distance, 0·4in. to 2·2in. face width, and 16 to 2·5 D.P.

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Gleason Generators are Versatile

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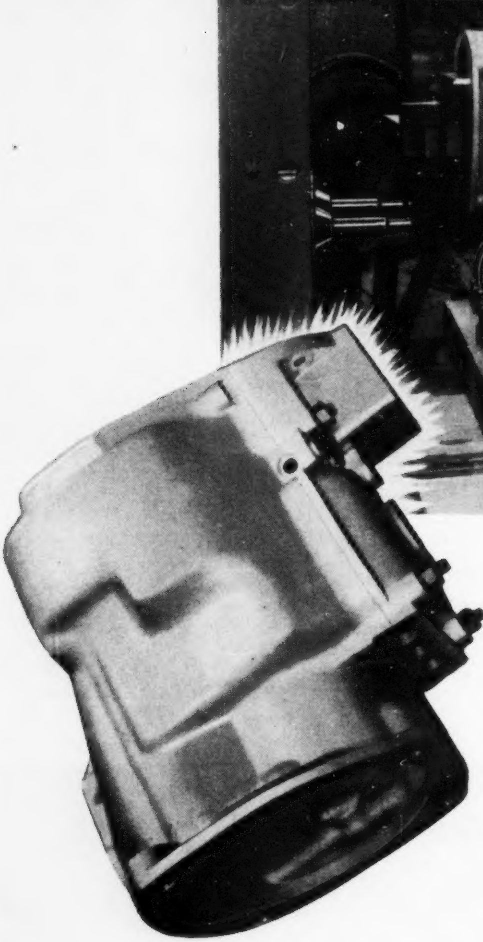

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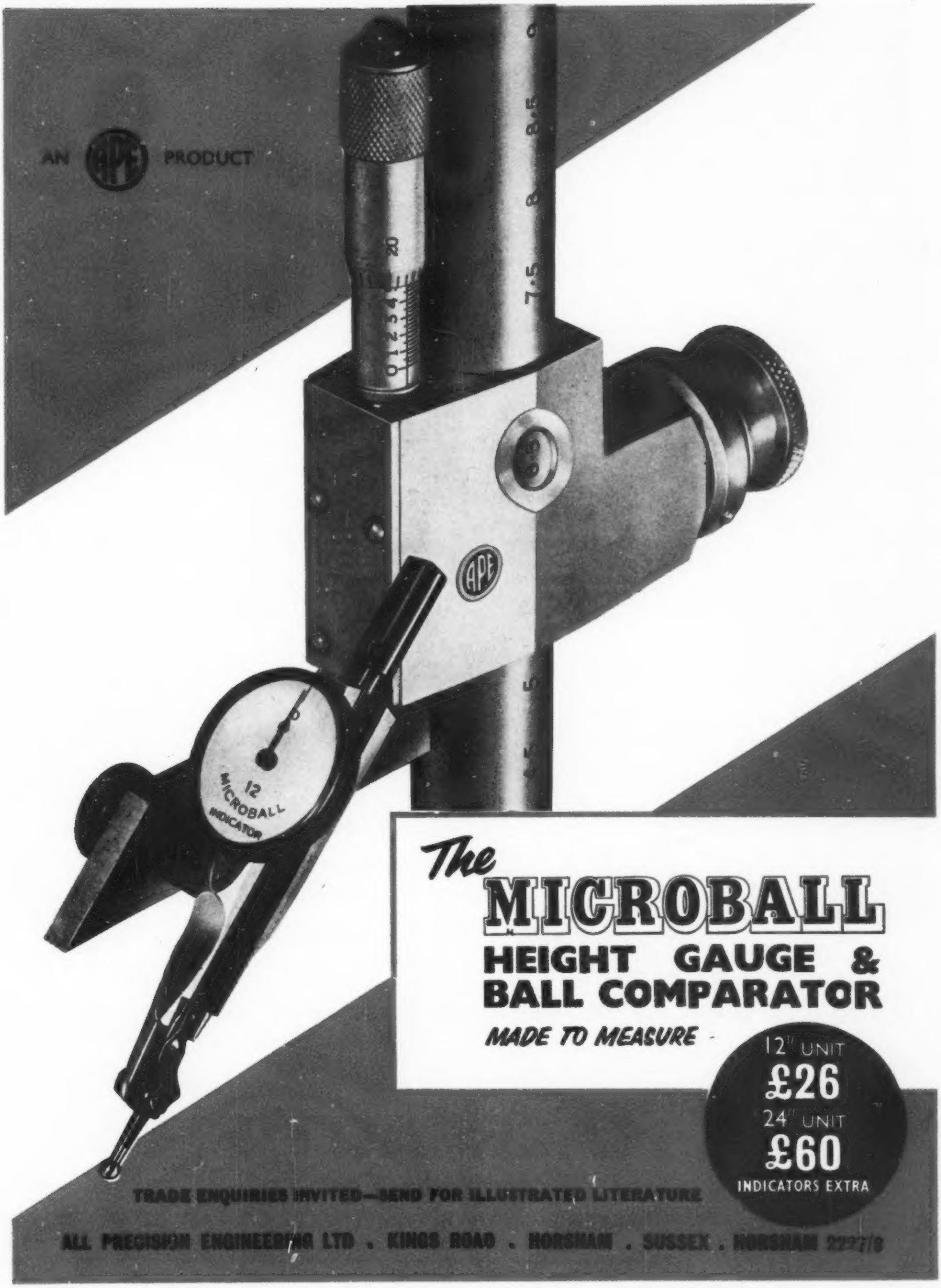
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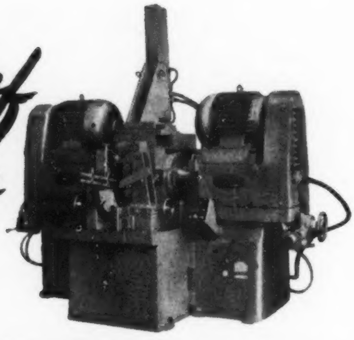

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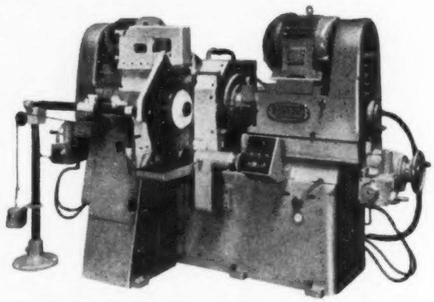

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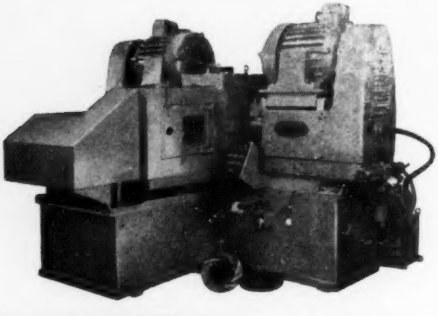

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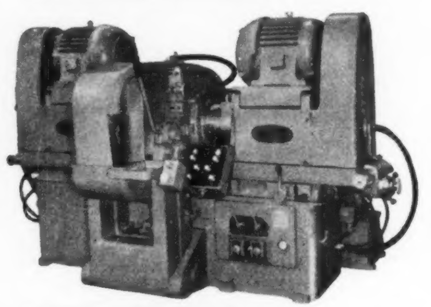

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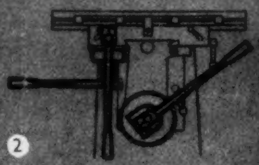
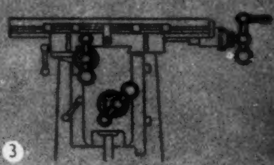
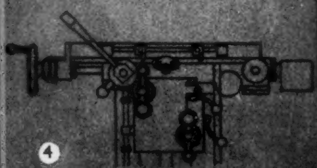


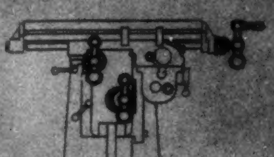
2 Hand Feed—lever, lever, lever.



3 Hand Feed—Screw, screw, screw.



4 Multiform—semi-automatic cycle.



5 Normal automatic feed.

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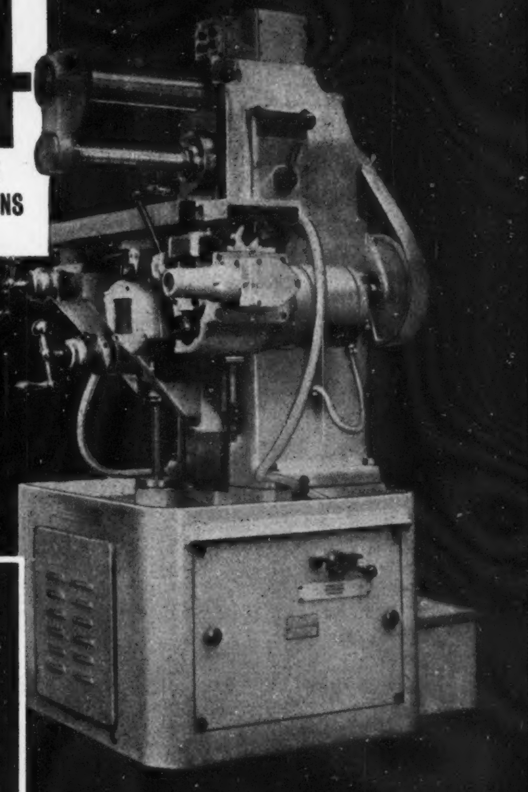

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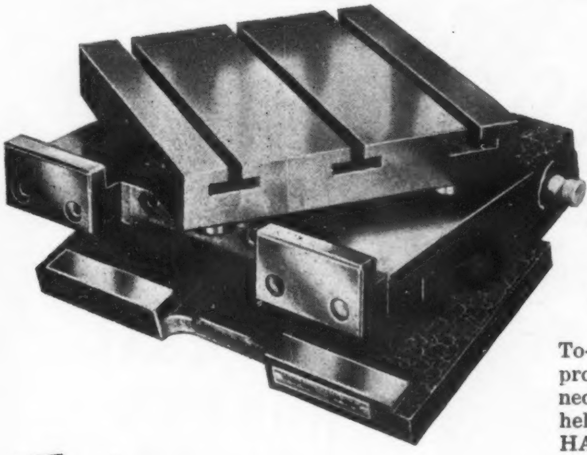

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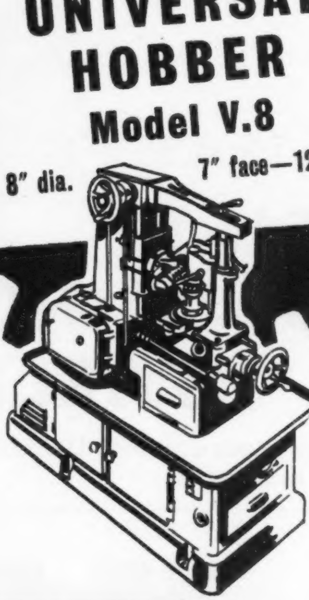

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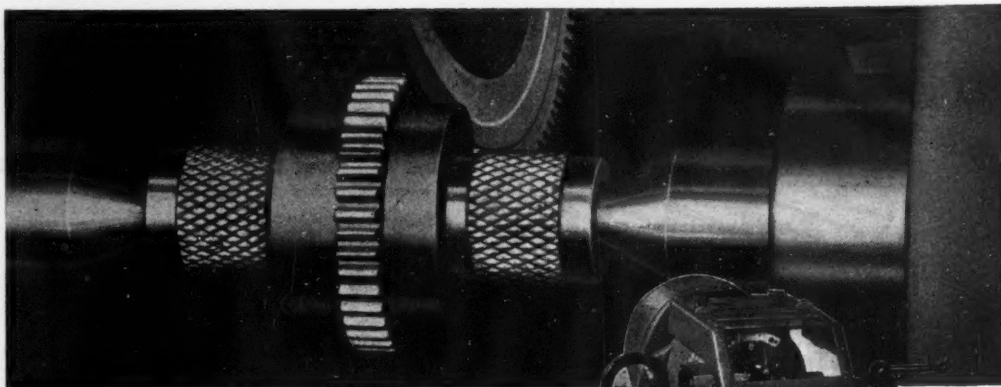

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highest accuracy, best surface finish and quietest operation is achieved by gears which have been shaved. If the fine pitch gears you produce have a total composite error of more than 0.0003 inches, you should find out more about the VS4A.

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Indicating shaft speed, showing use of extension.

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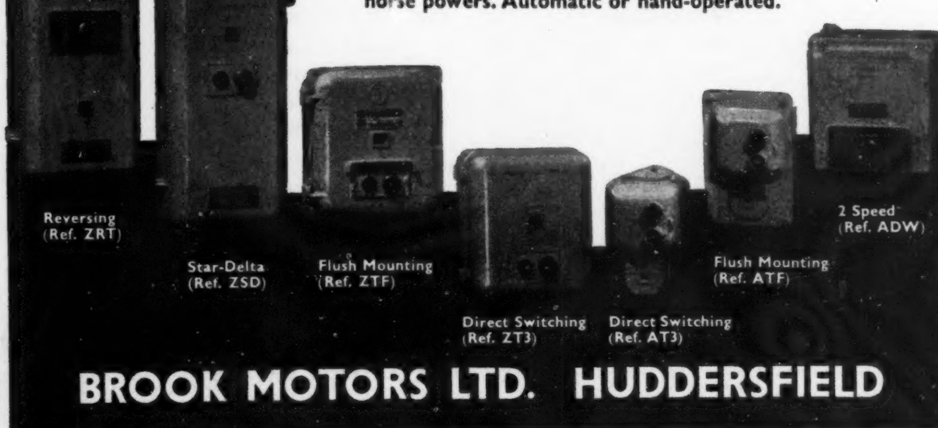

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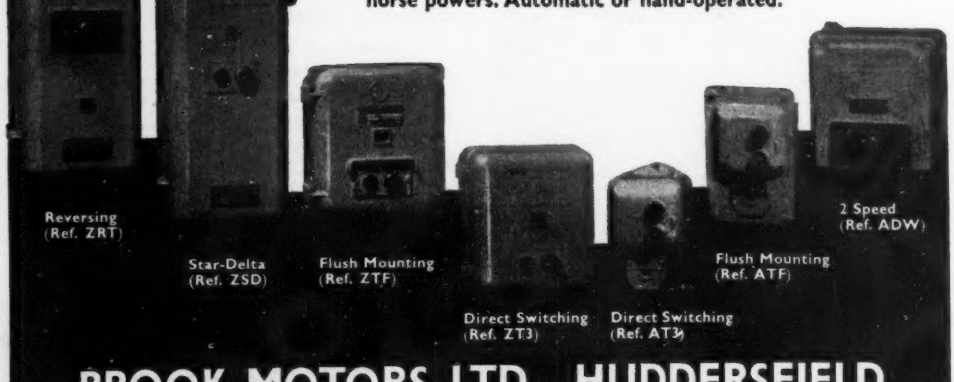

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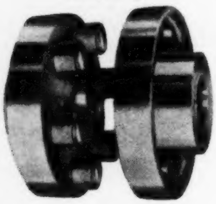

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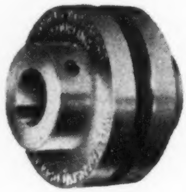

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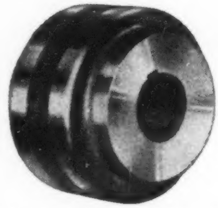

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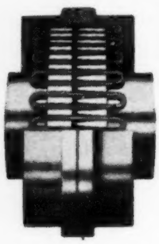

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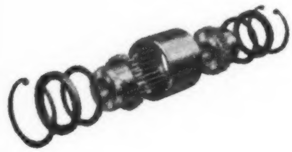

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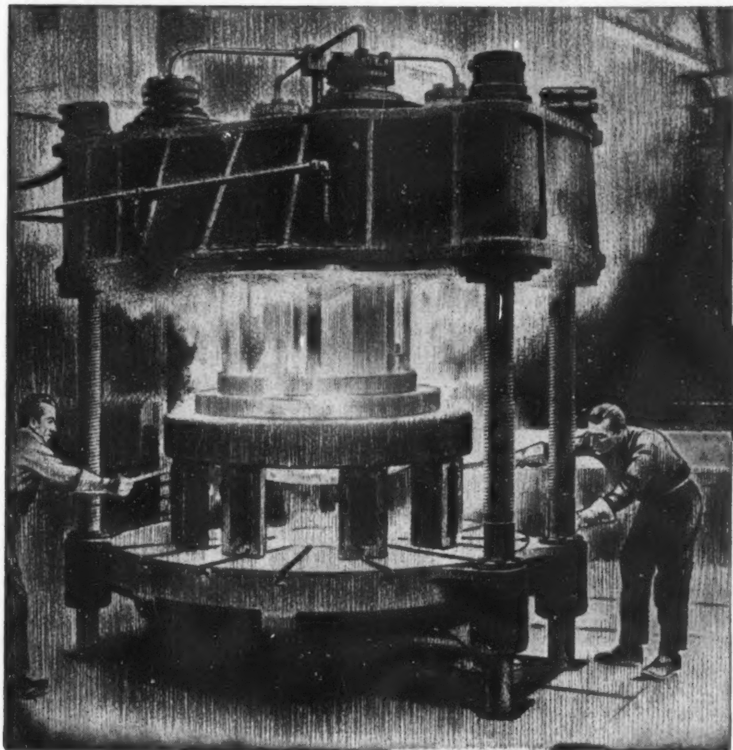

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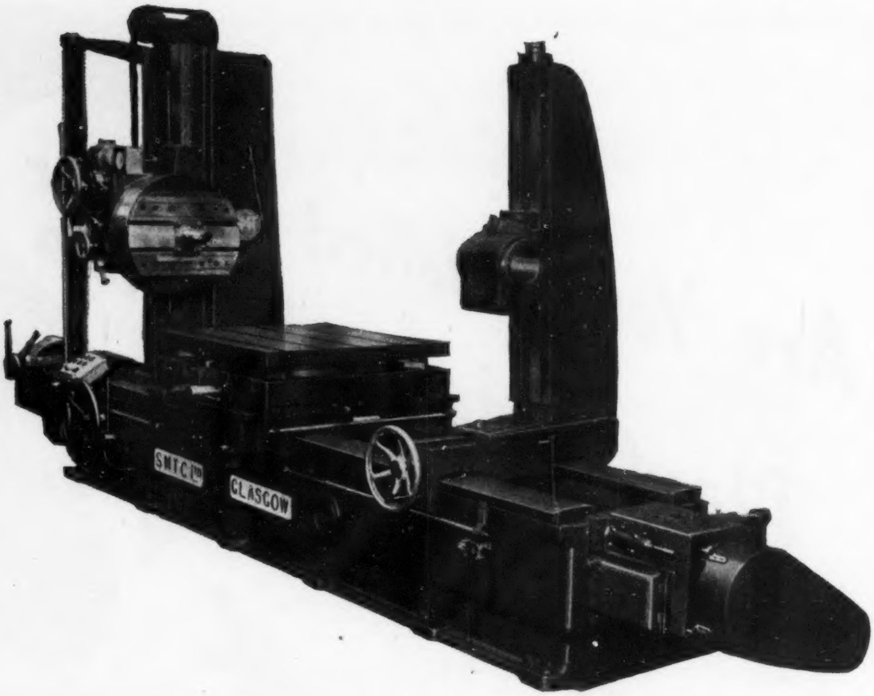

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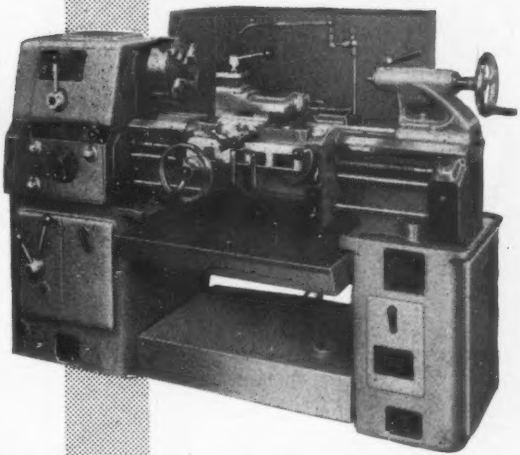

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Patented totally enclosed feed box providing wide range of threads and feeds.

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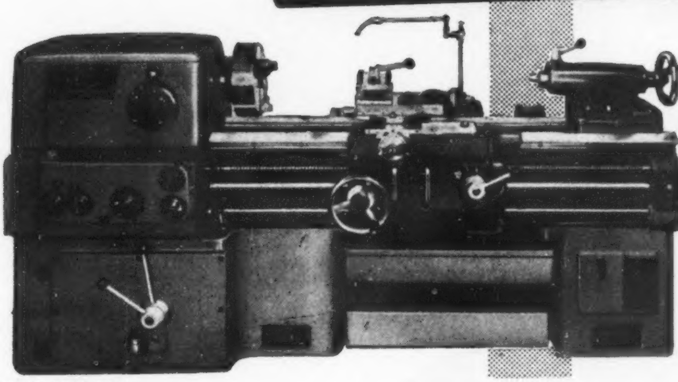

8½ in. S.S. and S.C. LATHE

Gap Bed 30in., 48in. or 80in. alternatively Chip Flow Bed 48in. or 80in.

18 spindle speeds 20 to 970 r.p.m., higher or lower ranges optional.

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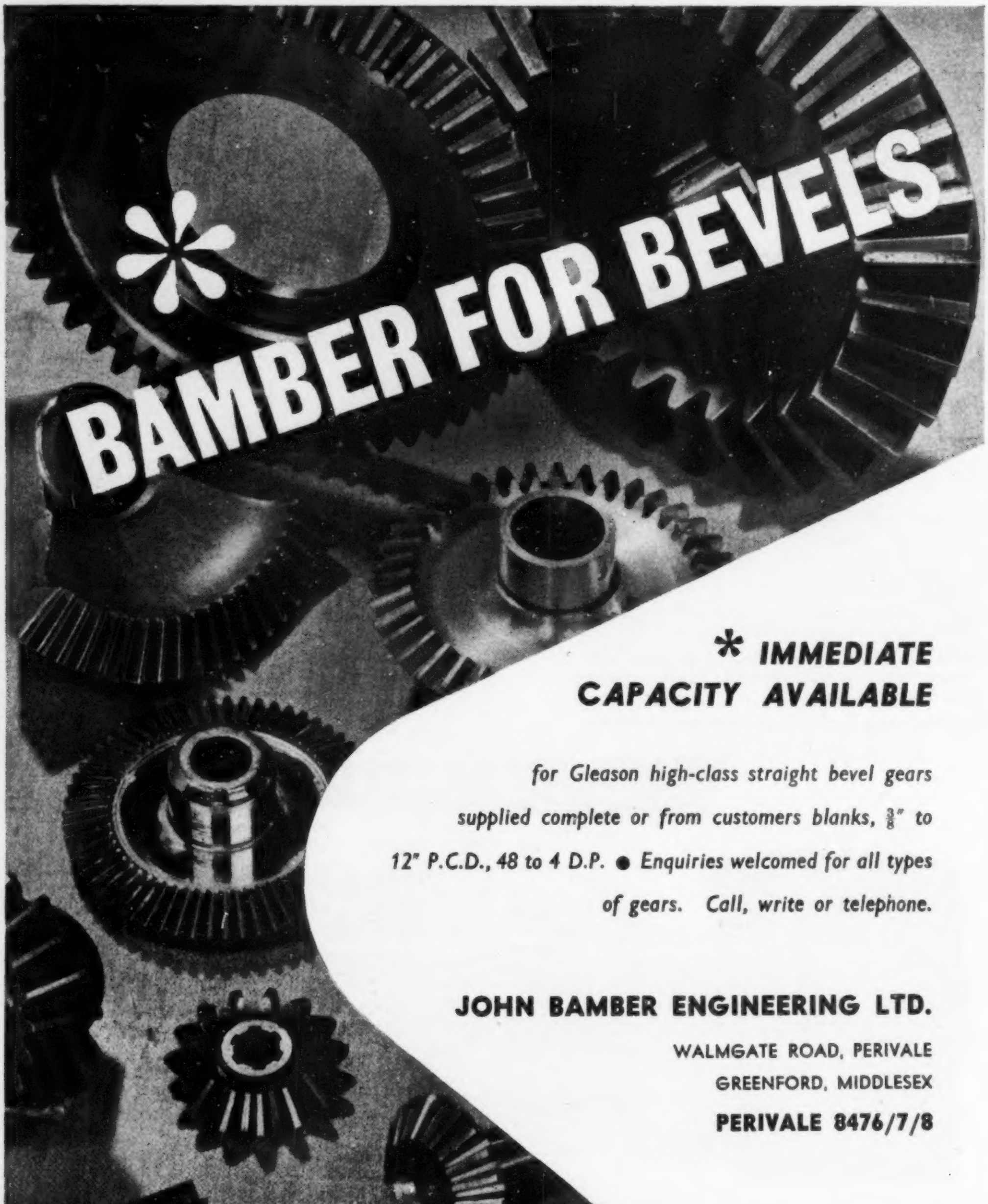

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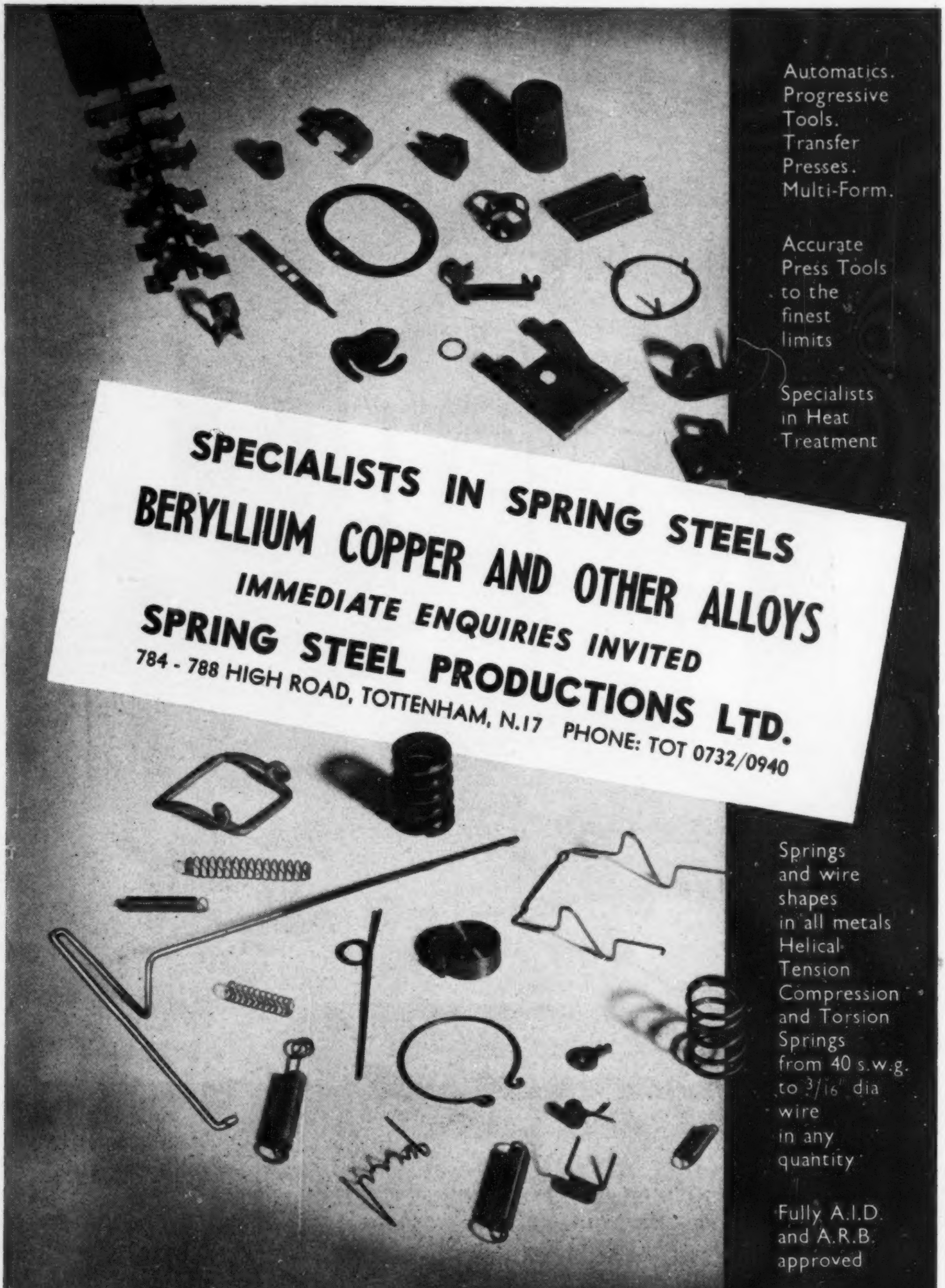
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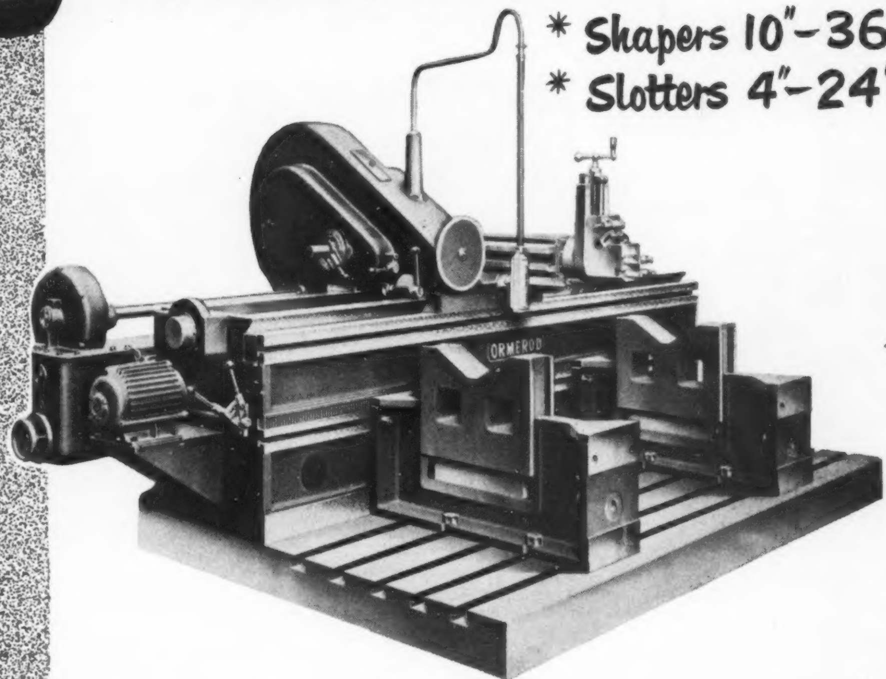

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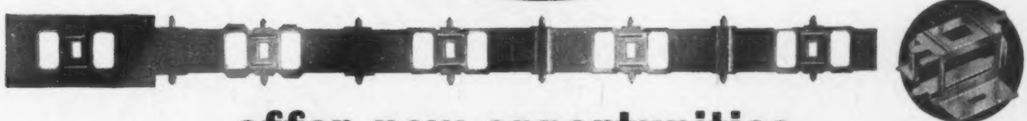

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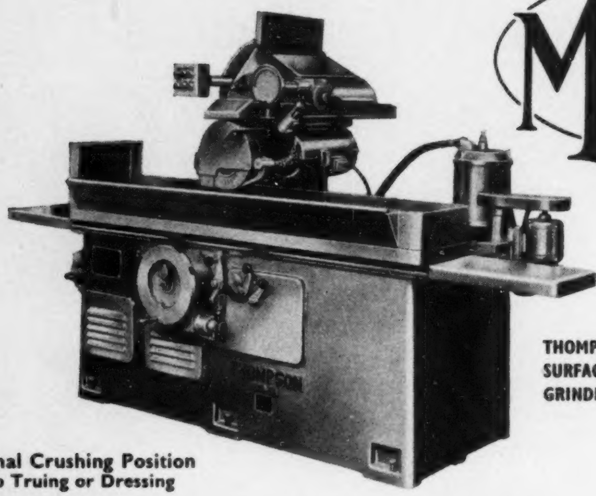

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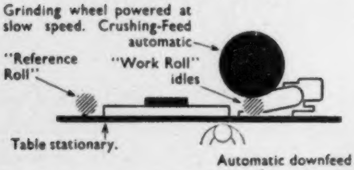

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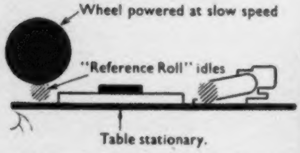
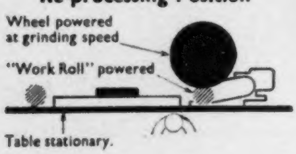


Re-processing Position



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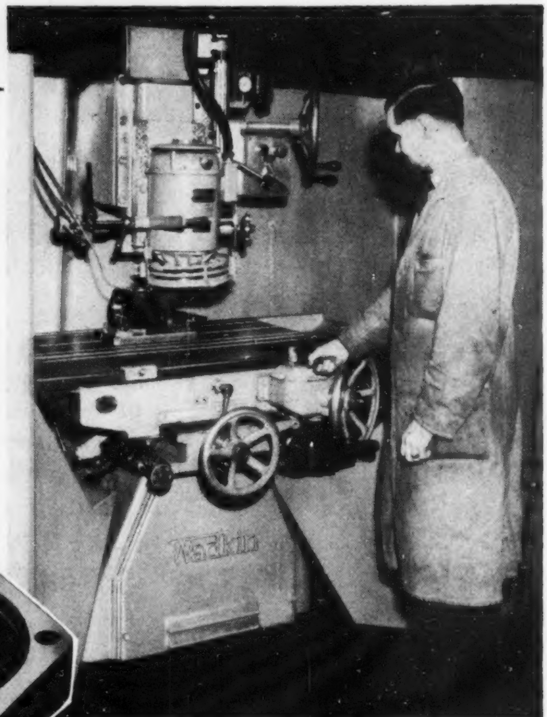

Wadkin Vertical Milling Machine L.H.1. with cutting speeds up to 18,000 r.p.m. face milling a steering box. Photographs by courtesy of Rolls-Royce Ltd., Crewe.

This steering box is face machined in 20 seconds!

Rolls-Royce Ltd., like many other famous firms, appreciate the benefits of using a machine specially designed for milling Non-ferrous metals. Their Wadkin Vertical Milling Machine L.H. face mills their light alloy components, such as the steering box shown above, in a fraction of the time taken by any other method. And it does so with the accuracy and finish associated with Rolls-Royce standards. The Wadkin type L.H. consists of one basic machine of plain, robust and inexpensive design, with three alternative head arrangements. Each head has cutting speeds far higher than orthodox millers, permitting feeds as high as 84" per minute. Leaflet No. 811, giving full details will be sent on request.

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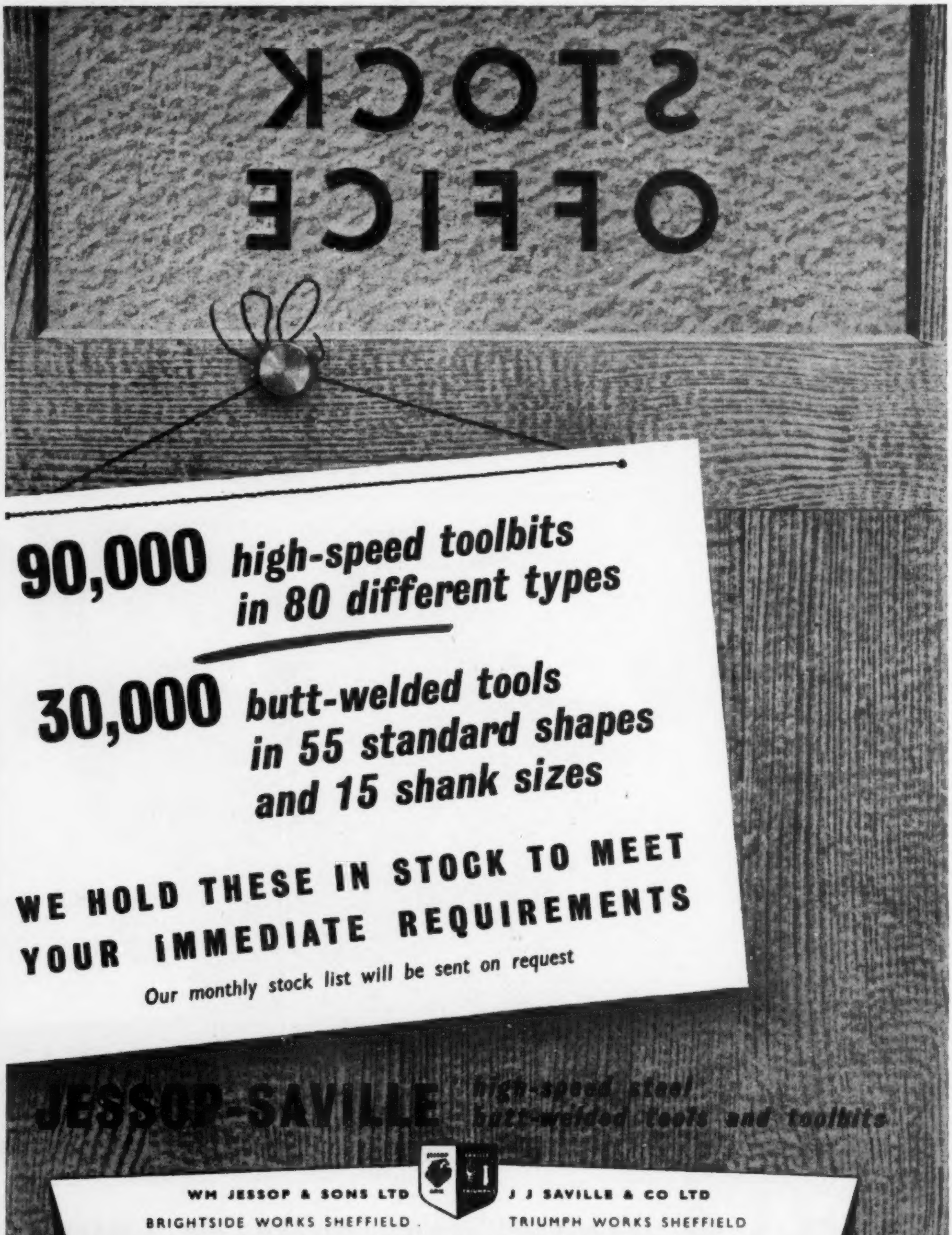
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Electrical Aids in Industry *Data Sheet* **No. 1**

Electro-Heat

The ways in which electricity can be used to advantage in industry are many and varied. Some are well known but others are not known well enough. For this reason the Electrical Development Association has prepared a series of detailed data sheets on various applications which will be printed in this journal from time to time.

All the applications of electro-heat have these advantages in common :—

1 Electro-heat is clean both in regard to its application and the method of generation.

2 It can easily be controlled more precisely than any other form of heat, manually or automatically.

3 It can be brought to the job instead of having the job brought to it.

4 It permits better use of floor space and the elimination of unnecessary handling.

5 In many of the newer processes it is the only possible form of heat which can be used.

6 It often ensures a higher quality of products with fewer rejects.

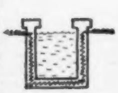
7 It gives the best working conditions.

8 It effectively reduces or eliminates fire and explosion hazards.

Below will be found brief notes on some of the various methods of generating heat by electricity.

Resistance Heating

This is the best known form of electric heating. The elements provide a high resistance to the passage of electricity and thus heat is generated. It can be used in furnaces for melting or heat treatment of any material whether metal or not, or the resistance of the workpiece itself can cause the generation of heat.

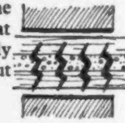


Induction Heating

Eddy currents are induced in the surface of a conducting workpiece, heating it up. The depth to which this heating will penetrate is determined by the time it is given.

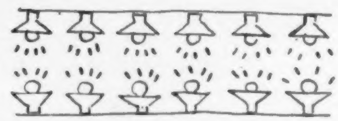
High-frequency Dielectric Heating

This form of electro-heat can be used only on non-conducting materials such as wood, plastic and rubber. The material is placed between two electrodes to which a high voltage is applied at a high frequency. This has the effect of generating heat inside the material rapidly and uniformly throughout its entire thickness.



Infra-red Heating

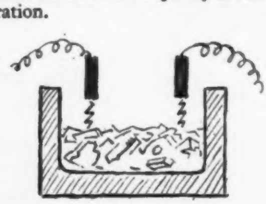
This method employs pure radiant heat. The bulk of the radiation takes place in the infra-red portion of the radiation frequency spectrum. The heaters may take the form of reflector lamps or sheathed wire elements. The method is extremely flexible and has many uses, including paint drying and pre-heating plastics.



Arc Melting

This form of heating is chiefly used for melting steel. The diagram illustrates one method of operation.

Very large charges can be melted; melting units of 200 tons capacity are now in operation.



The Application of Electro-Heat

All these methods of electric heating can be applied in almost an infinite variety of ways. Some of these ways will be dealt with in subsequent sheets.

For further information, get in touch with your Electricity Board or write direct to the Electrical Development Association, 2 Savoy Hill, London, W.C.2.

Excellent reference books on electricity and productivity (8/6 each or 9/- post free) are available — "Induction and Dielectric Heating" is an example; "Resistance Heating" is another.

E.D.A. also have available on free loan a series of films on the industrial use of electricity. Ask for a catalogue. 4889/4

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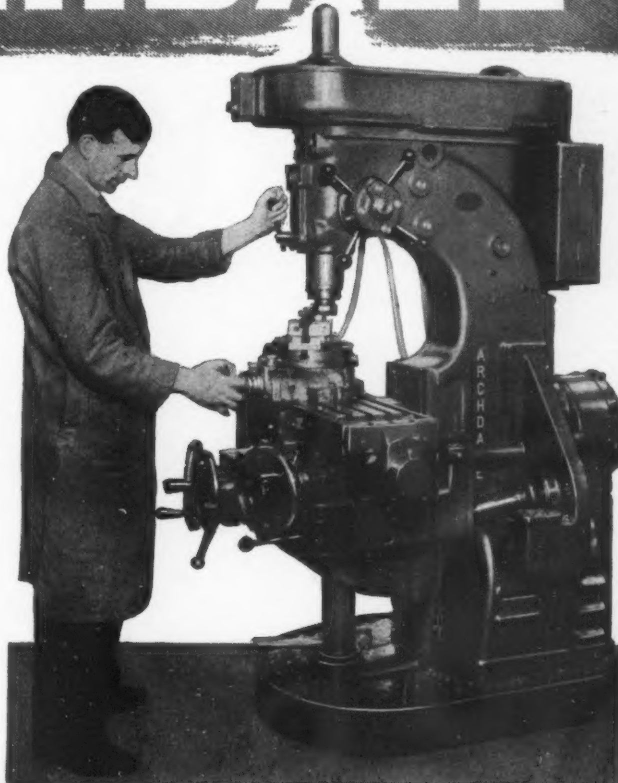

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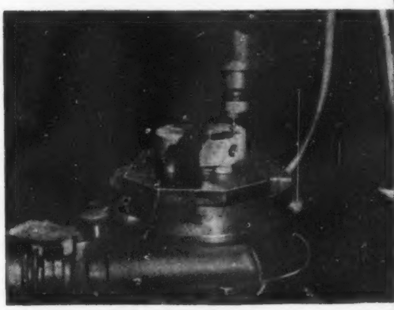

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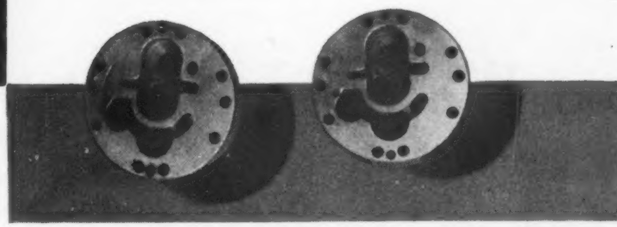

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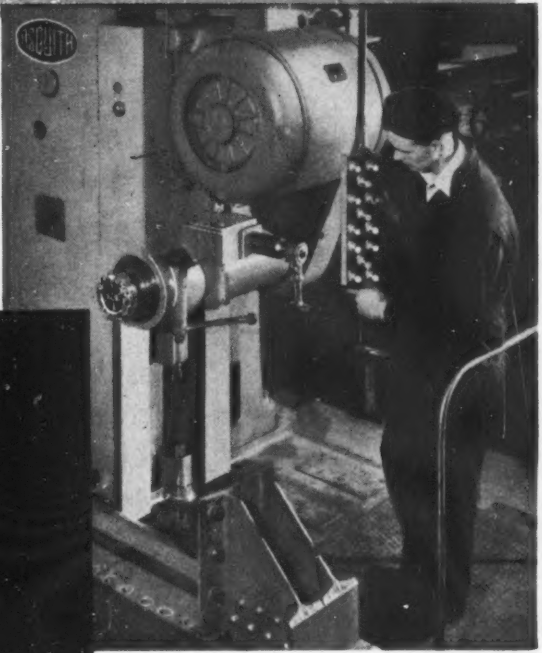

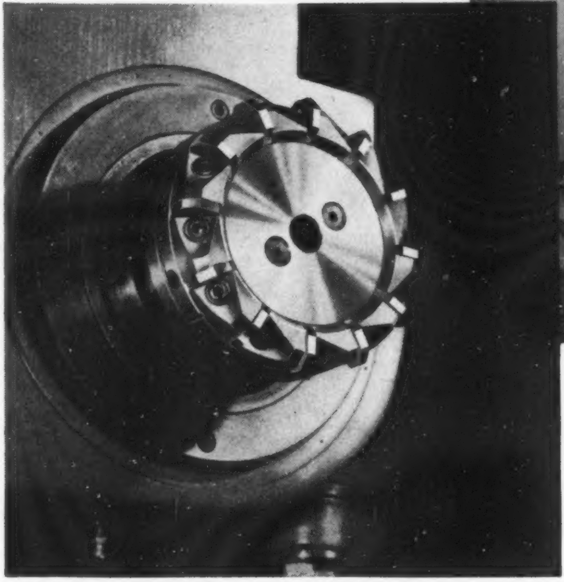

The 'Prolite' Futur Mill has been selected for use on the new Girder End Facing Machine manufactured by William Asquith Ltd. of Halifax.

This cutter has proved itself to be ideal for this and similar applications within the constructional steel industry because of the simplicity of servicing, no elaborate cutter grinding being necessary. Its usefulness is, however, not confined to one particular industry; wherever face milling is undertaken the Prolite Futur Mill can prove its merits.

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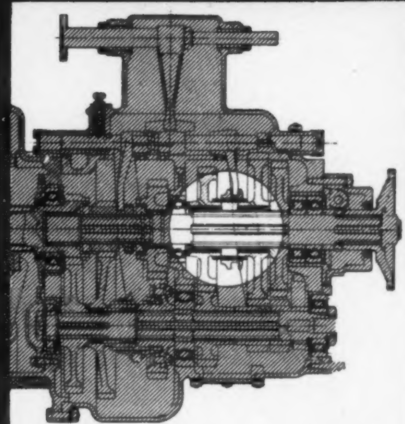
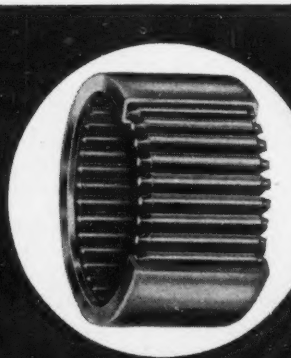


The Henry Meadows Type 450 C5 five-speed gearbox, in which Torrington Needle Bearings support mainshaft gears, transmits the power in the Guy 'Invincible' Chassis.



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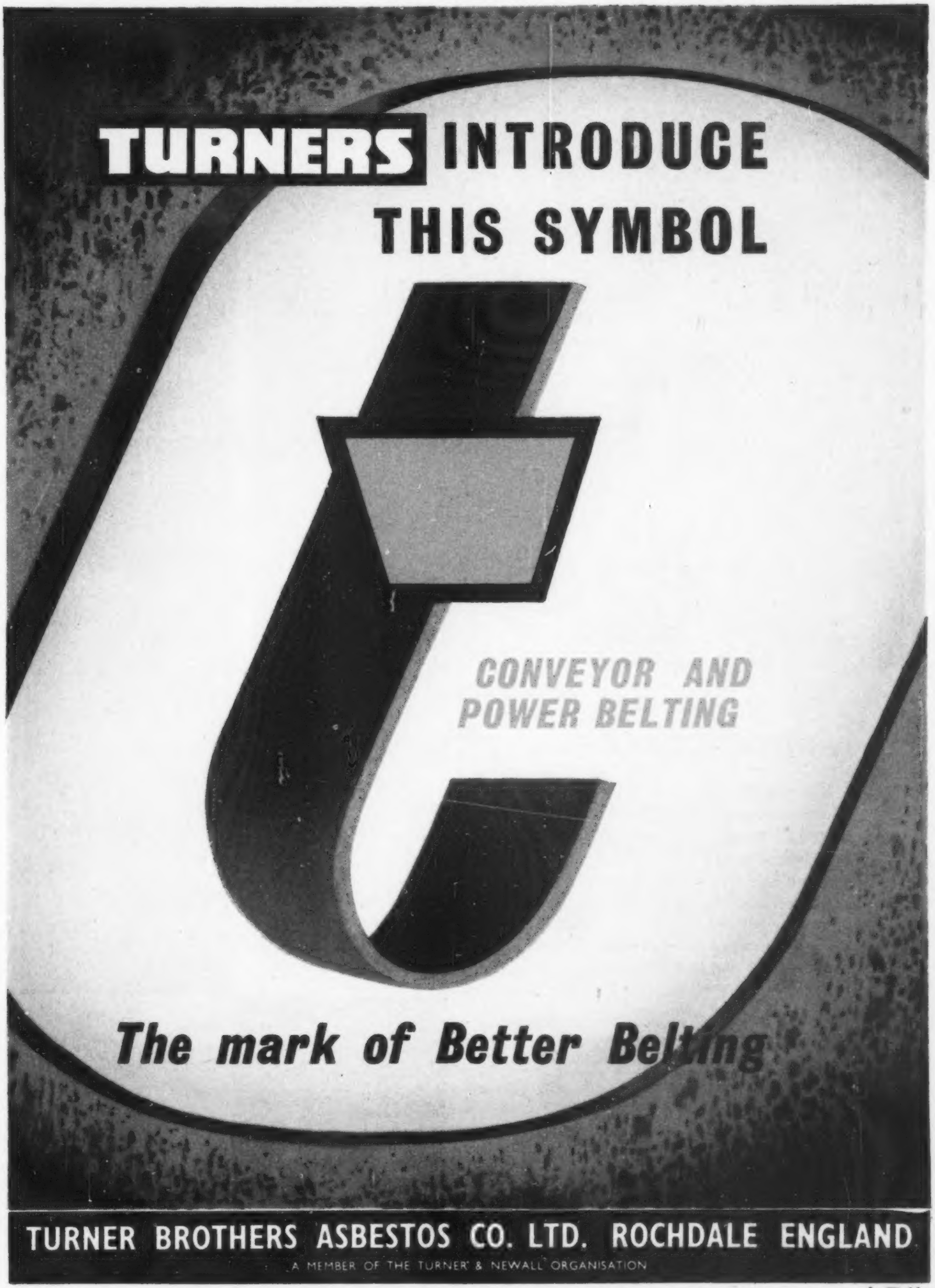
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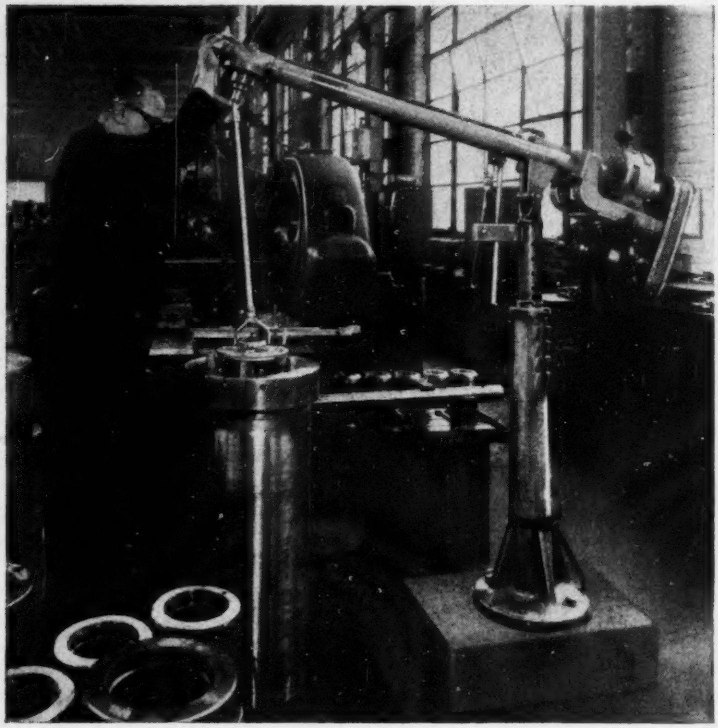

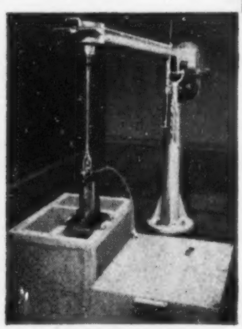


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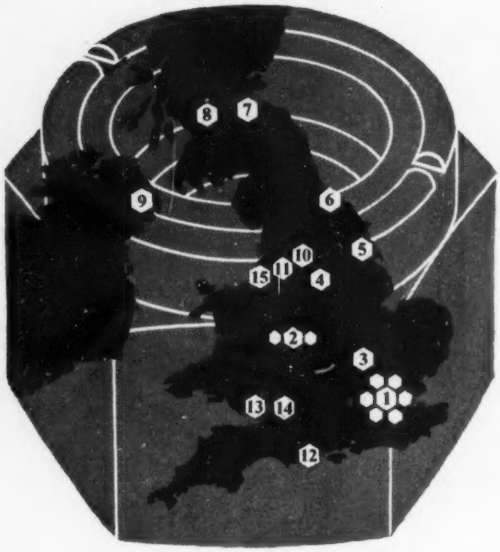

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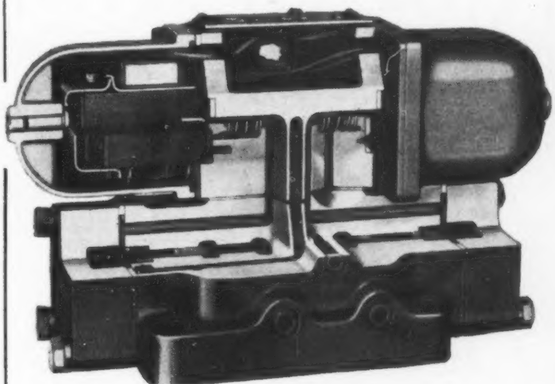
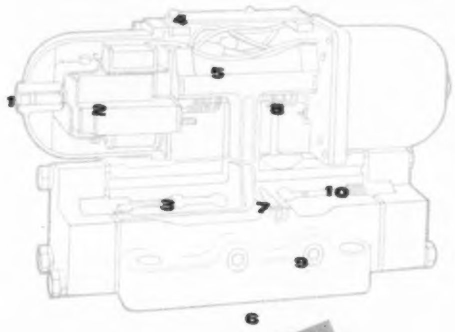
The NEW improved design of the VICKERS-DETROIT solenoid pilot operated directional valves

EASIER INSTALLATION
LESS MAINTENANCE
LONGER SOLENOID LIFE

1 *Provision for manual shift of spool with dustproof and moistureproof seal*
2 *Standard continuous duty solenoid (safety interlock with cover)*
3 *Ample porting for large capacity*
4 *Sealed and chained nameplate cover reversible for reading*
5 *Ample wiring space — $\frac{3}{4}$" B.S. conduit connections on 2 sides*
6 *Gasket or subplate (Threaded conn.) mounting*
7 *Readily converted for internal or external pilot pressure*
8 *Pilot spool retained when solenoids removed*
9 *Test connections*
10 *Precision ground surfaces*





British Made
VICKERS-DETROIT
OIL HYDRAULICS

VICKERS-DETROIT hydraulic 2- and 4-way valves provide the optimum in directional control. They are compact, versatile, and are designed for heavy duty, continuous and rapid cycling operation on all types of industrial machinery. More than a decade of application experience and years of research and development back all the valves' features.
Seven spool types satisfy a wide variety of circuit needs and operate at pressures to 3000 psi.
Installation is simplified with ease of wiring and a minimum of piping. The valves are available for gasket or sub-plate mounting. Mounting position is unrestricted except in "no-spring" models.
The valves conform to JIC Standards and are available in $\frac{1}{8}$" and $\frac{1}{4}$" direct solenoid operated models . . . $\frac{3}{4}$" and $1\frac{1}{4}$", solenoid controlled pilot operated models.
For further information, write for Publication 1 /43.

STAND NO. 502: NATIONAL HALL GALLERY, PUBLIC WORKS & MUNICIPAL SERVICES EXHIBITION—Olympia, Nov. 10-15.

by STEIN ATKINSON VICKERS HYDRAULICS LIMITED

S.A.V. HYDRAULI **197 Knightsbridge London S.W.7**

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Danger—flying sparks! Danger—molten metal! Danger—splashing acids! Tough, clear and shatter-proof, Celastoid acetate sheeting is a safe shield against so many industrial hazards. Uniquely suitable for visors, goggles and machine guards, Celastoid does not shatter, crack or splinter. Between the worker and his work Celastoid provides economic and lasting protection.

need the safety of

* *The Celanese Technical Advisory Service, with its unrivalled experience, is freely available to assist you with any special safety problems you may have.*

Celastoid

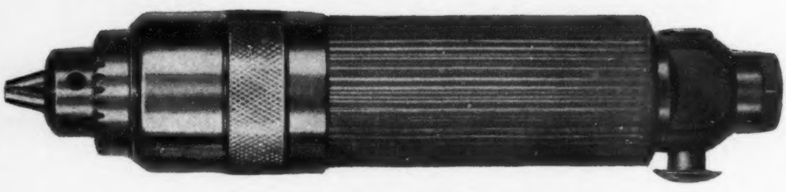
ACETATE SHEET

*Shatterproof Celastoid is a **product** of the*

PLASTICS DIVISION, BRITISH CELANESE LTD., HANOVER SQUARE, LONDON W.1 MAYfair 8000

Never satisfied! Always improving! A steady progress towards perfection—burbled the Managing Director in his most self-satisfied voice.
Take Pneumatic Drills. Efficient, you say—but perhaps a trifle noisy for the assembly line.
Sir, you are living in the past. This Little Horse here ("this 'ere Little Horse, if you please" muttered the Little Horse in question) operates a drill. Note that we have fitted him with a kind of gag or muffler, thus reducing the operating noise level by more than 50%. The principle is really very simple—as I will now demonstrate. I place this muffler over my mouth . . . so . . . I will now ask any member of the audience to wrap the ends—thank you sir,—round behind my ears . . . and N'mm M'mm Er'rm Ah'rmm Hurh'mm mm-m-mm . . .!
(The audience agreed that the noise level had indeed dropped by well over 50% and the Managing Director was carried out, black in the face, amid loud cheers).

These drills are now fitted with a chuck guard silencer and an improved plastic grip. Let us send you a leaflet giving you full details of the whole new range.

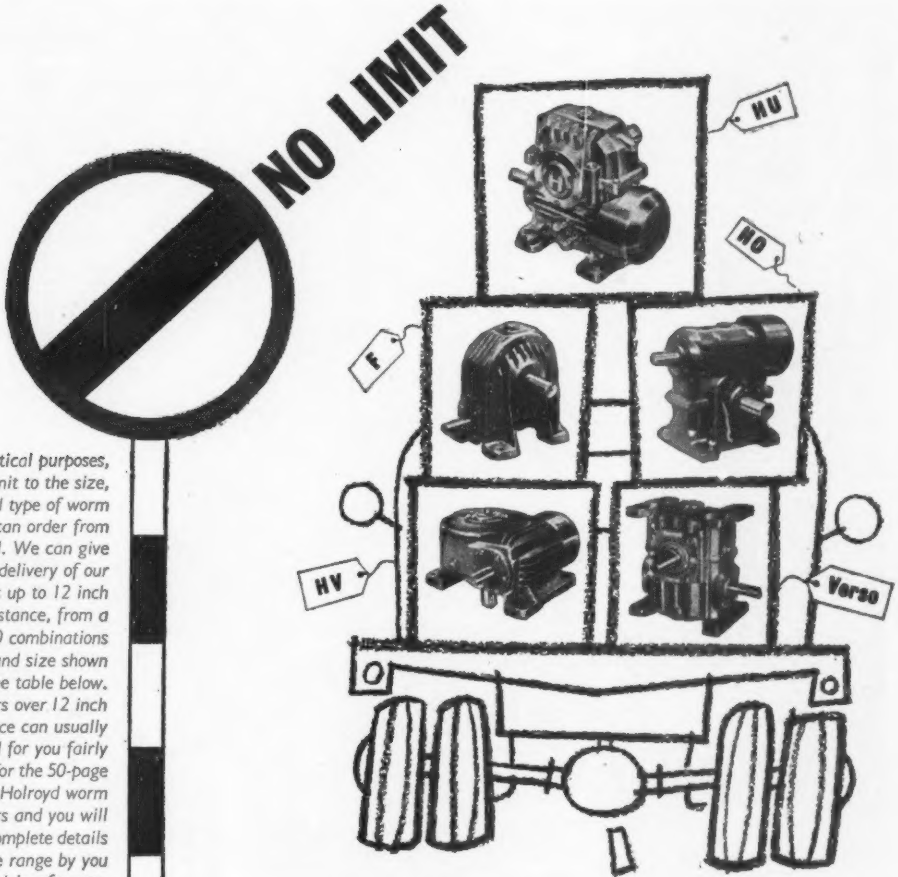


THE NEW **DESOUTTER SILENT** DRILLS

Manufactured by Desoutter Bros., Ltd., London.

DESOUTTER BROS. LIMITED, THE HYDE, HENDON, LONDON, N.W.9.
TEL: COLINDALE 6346. 'GRAMS: DESPNUCO, HYDE, LONDON.

CRC 281B



For all practical purposes, there is no limit to the size, ratio and type of worm reducer you can order from Holroyd. We can give immediate delivery of our standard units up to 12 inch centre distance, from a choice of 340 combinations of type, ratio and size shown in the table below. Reduction gears over 12 inch centre distance can usually be assembled for you fairly quickly. Send for the 50-page book about Holroyd worm speed reducers and you will always have complete details of the whole range by you for quick reference.

Holroyd HU	Single reduction underdriven with horizontal input and output shafts. Centre distances 3, 4, 5, 6, 7, 8, 9, 10 and 12 inches.
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Holroyd HV	Single reduction with vertical output shafts and horizontal input. Centre distances 3, 4, 5, 6, 7, 8, 9, 10 and 12 inches.
Holroyd Verso	2½ inch centre distance. Suitable for underdriven, overdriven or side mounting.
Holroyd F	Made in three sizes—1¼, 1¾ and 2½ inch centre distance, and suitable for a variety of mounting positions.
All the above are available with any of the following ratios:—5, 7½, 10, 15, 20, 25, 30, 40, 50, 60 and 70 to 1.	

All these can be delivered from stock

Holroyd

90 YEARS OF GEARS

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CRC 191


This large SKODA LATHE was supplied by The Selson Machine Tool Co., Ltd., to the new Faringdon (Leyland) Factory of BTR Industries Ltd., by whose courtesy this photograph is reproduced.
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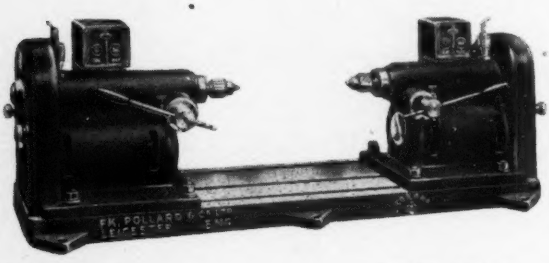
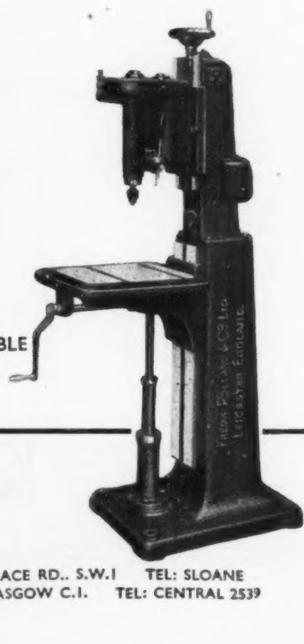
BENCH MACHINE UP TO SIX SPINDLES

SINGLE OR MULTIPLE SPINDLE MODELS TO SUIT EVERY NEED

- ***ADJUSTABLE HEADS***
- ***$\frac{5}{16}$in. CAPACITY DRILL CHUCK***
- ***8 SPEEDS THROUGH PICK-OFF GEARS***



MODEL 15 HFHD
DOUBLE END WITH ADJUSTABLE HEADS
CAN BE SUPPLIED WITH COUPLED FEED
ALSO AVAILABLE WITH SINGLE HEAD



MODEL 15 HA
COLUMN MACHINE
WITH ADJUSTABLE TABLE
UP TO SIX SPINDLES

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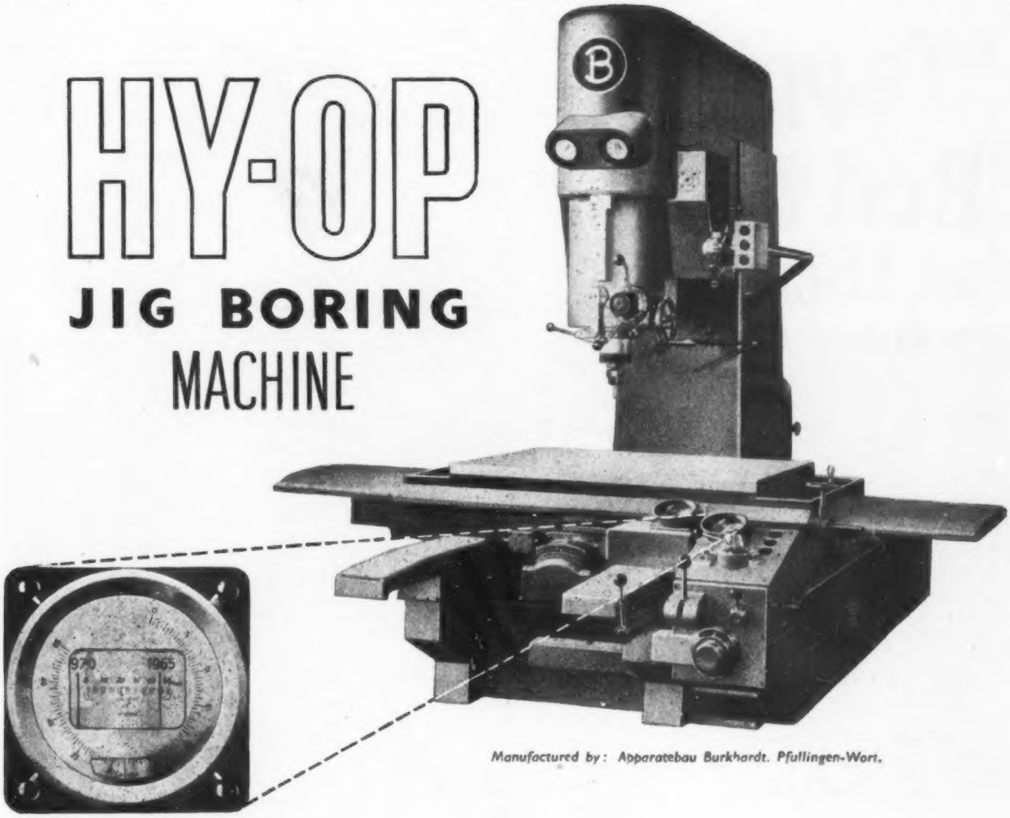
HY-OP
JIG BORING MACHINE



Manufactured by: Apparatebau Burkhardt. Pfullingen-Wort.

Direct optical reading of co-ordinates.

B O R I N G I S N'T I T ?

We beg you will not trouble to read this—unless, of course, you are interested in the precision boring of jigs, machine tool parts, prototypes or single components to the greatest accuracy. The HYOP 54 Co-ordinate Machine, designed primarily as a high-precision jig-borer, will handle, also, finish-milling, internal grinding and honing. Hydraulic control—infinitely variable in all directions—of the table and sliding head, with **infinitely variable** spindle speeds, give this machine its very considerable versatility.

Specialised design has achieved both great capacity and an extremely fine surface quality. The HYOP 54 has an **optical measuring** system which gauges, on its luminous screen, accurately to within 0·0002in. (Adjustment accuracy 0·0001in.)

We believe that never before have production-speed, high-quality finish and absolute precision been so effectively combined in one jig-borer.

In use at such famous factories as: Daimler-Benz, Citroen, Admiralty, Wavis Engineering, Renault, Volkswagen, etc. Also in America (6), Sweden and Japan.

Size of table 47¼in. by 30⅜in. Max. between table and spindle 25¼in. or special 35¼in. Boring rectangle 31¼in. by 24¾in.

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Tapping Rod Ends at Lockheed

Galtona
TRADE MARK

GROUND THREAD TAPS

GALTONA ground thread taps are widely used at Lockheed Hydraulic Brake Co., Ltd., because of their ability to maintain high precision and long life under all conditions of service.

On a five-spindle automatic for instance, track rod ends are blind tapped 1 in. U.N. 16 t.p.i. using a special GALTONA ground thread five-flute tap.

GALTONA ground thread taps, standard or special, can be supplied to give improved accuracy and finish on all materials. Illustrated catalogue available on request.

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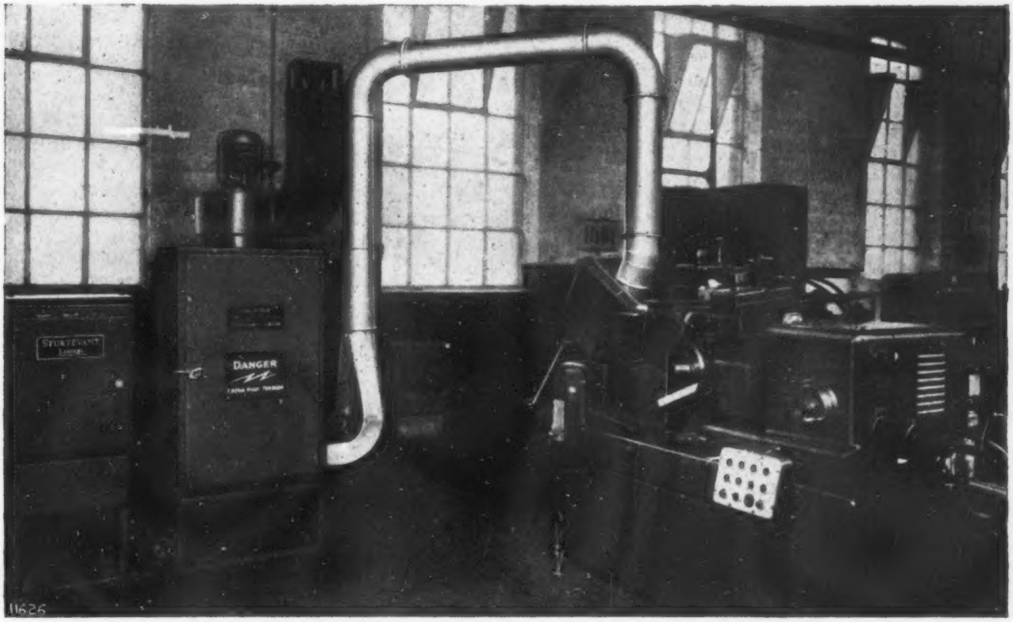
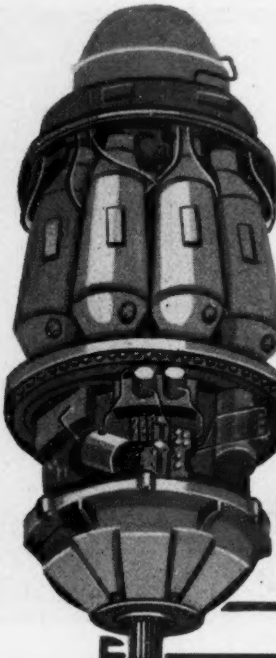
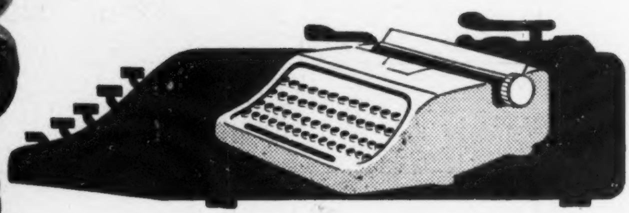


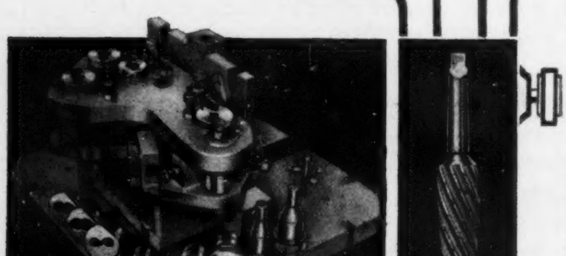
PRECIPITRON Electrostatic Oil Mist Filter serving a centreless thread grinder.



whatever your product...



BTG can offer a complete service



The Birmingham Tool & Gauge Company offers an unsurpassed service to an ever-increasing number of manufacturers in diverse fields of metal working. Although primarily manufacturers of special cutting tools of every description, both in High Speed Steel and Tungsten Carbide, our capacity embraces high quality precision engineering work and the manufacture of jigs, fixtures and inspection gauges. The same rigid adherence to meticulous standards of quality and finish that has always been reflected in our range of cutting tools, for which we have been renowned for nearly half a century, is now strictly observed in our new fields of activity.

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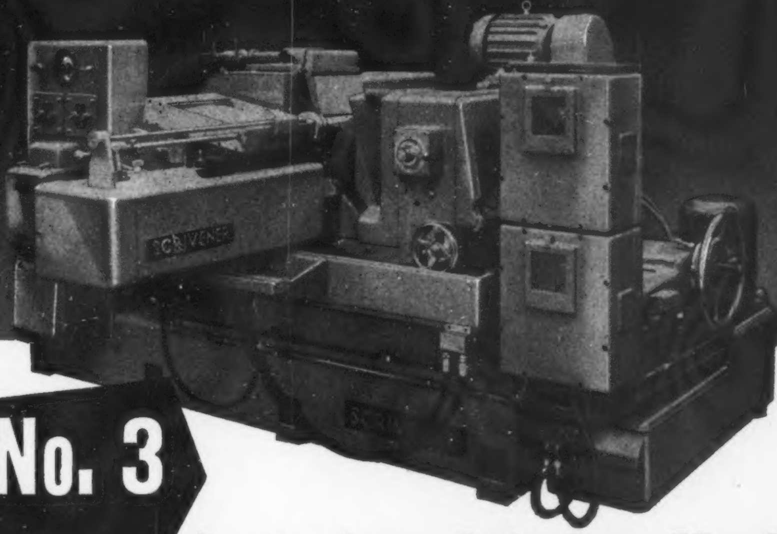
Beardmore

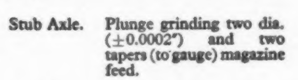
THE NEW SCRIVENER



No. 3

Centreless Grinding Machine

For continuous high production of precision ground parts the Scrivener feature of controlled cycle plunge grinding offers special economy unattainable by any other grinding method.
This example illustrates typical production.



Stub Axle. Plunge grinding two dia. (±0.0002") and two tapers (to gauge) magazine feed.

Total time. 30 seconds. 120 pieces per hour. Stock removed 0.012" to 0.015" in two passes.

The largest machine in the Scrivener range, this new Centreless Grinding Machine was introduced at the International Machine Tool Exhibition, and received wide approbation.

Employing the Scrivener system of controlled cycle operation, it demonstrated the plunge grinding of a stub axle in a total cycle time of 30 seconds (for two operations).

Scrivener machines incorporate, in addition to features for straight-through or hand-operated plunge grinding, a system for semi- or fully-automatic controlled cycle operation. By adopting the latter method, very economical mass production rates can be achieved, the machines feed, grind and eject in sequence and can be incorporated into automatic production lines.

The complete range comprises:

Model	No. 1D	No. 2	No. 3
Grinding wheel dia. and width	12" × 3"	20" × 6"	20" × 10"
Control wheel dia. and width ...	7" × 3"	12" × 6"	14" × 10"
Max. opening between rear wheels...	2½" *2"	6" *4½"	9" *9"

*Machines with controlled cycle operation.

WICKMAN LIMITED

FACTORED MACHINE DIVISION, FLETCHAMSTEAD HIGHWAY, COVENTRY

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Something New!

CEJ "HI-TEN" TAPS

HAVE YOU ANY REALLY TOUGH TAPPING PROBLEMS IN HIGH TENSILE STEELS?

A NEW MANUFACTURING PROCESS IS GIVING AMAZING RESULTS AND MUCH LONGER TAP LIFE ON THESE DIFFICULT MATERIALS

★ **Tell CEJ about your problems and they will find the answer**

C.E. JOHANSSON LTD.

SOUTHFIELDS ROAD, DUNSTABLE, BEDS.

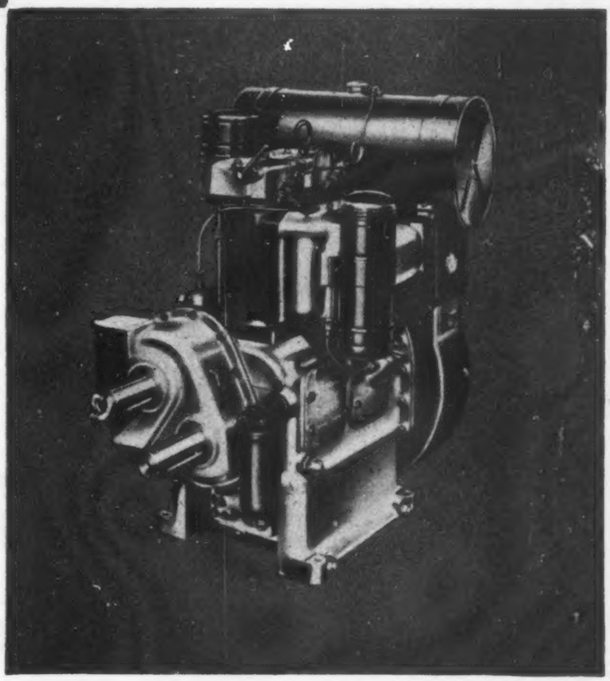
DBH/7097

Q

What does it cost to drive a 10 kW Generator from a 14/22 h.p. Armstrong Siddeley Air Cooled Diesel?

A

$0.01385 (1.175d.) per kW/hour*



** Figure supplied by Gt. Raymond Paper Co. of Lac Brûlé, Canada.*

ACTUAL COSTS FOR 2606¼ HOURS RUNNING WERE:
Diesel fuel (less tax : 1178 gals.)......$259.27
Lubricating oil, filters etc................ $81.71
Spare parts (fuel filter assembly)...... $20.35
Fuel consumption (Gals/Hour).........0.441

YEARS OF KNOW-HOW: The diesel engines are manufactured with the same precision as Armstrong Siddeley's world-famous aero engines.

MATERIAL - CHECKED: Armstrong Siddeley experts regularly visit suppliers of materials and components to check on their quality controls.

PRODUCTION - CHECKED: As well as the standard bench test, which every engine undergoes, far more extensive tests are regularly made on engines taken at random from the production lines and all ASM diesels are approved by Lloyds and the Dutch Bureau Veritas.

THERE IS NO MORE RELIABLE DIESEL ENGINE.

Three models: 6-11 h.p., 14-22 h.p., 20-33 h.p.

Write now for brochures.

ARMSTRONG SIDDELEY Air Cooled Diesels

ARMSTRONG SIDDELEY — COVENTRY AND BROCKWORTH, ENGLAND

A MEMBER OF HAWKER SIDDELEY / *ONE OF THE WORLD'S INDUSTRIAL LEADERS*

Churchill

HBM

AUTOMATIC SIZING

INTERNAL GRINDING MACHINE

CHURCHILL Automatic Sizing Internal Grinding Machines are renowned for their accuracy and speed of production. The extensive experience gained from supplying very many machines has been fully utilised in the Model 'HBM' to ensure highly efficient operation over a wide range of work.

Single or double automatic cycle operation according to work.
Plunge cut and traverse grinding.
Feed accelerator reduces production time.
Exceptionally wide range of roughing and finishing feeds.
Diminishing rate of feed to zero with variable electric dwell at size position.
Adjustable oscillation for building-up finish on blind end and open short length bores.
Hand feed to dead stop for plain internal grinding.
Operational safety—provision for immediate interruption of automatic cycle for emergency run-out—enclosing of dogs and plungers eliminates "finger traps".
Can be equipped for combined hole and face grinding.

ASSOCD BRITISH MACHINE TOOL MAKERS LTD

THE CHURCHILL MACHINE TOOL CO. LTD., BROADHEATH, nr. MANCHESTER
Telephone: Altrincham 3262 Telegrams: Churchale, Manchester

Export Sales Organisation: Associated British Machine Tool Makers Ltd, London Branches and Agents.
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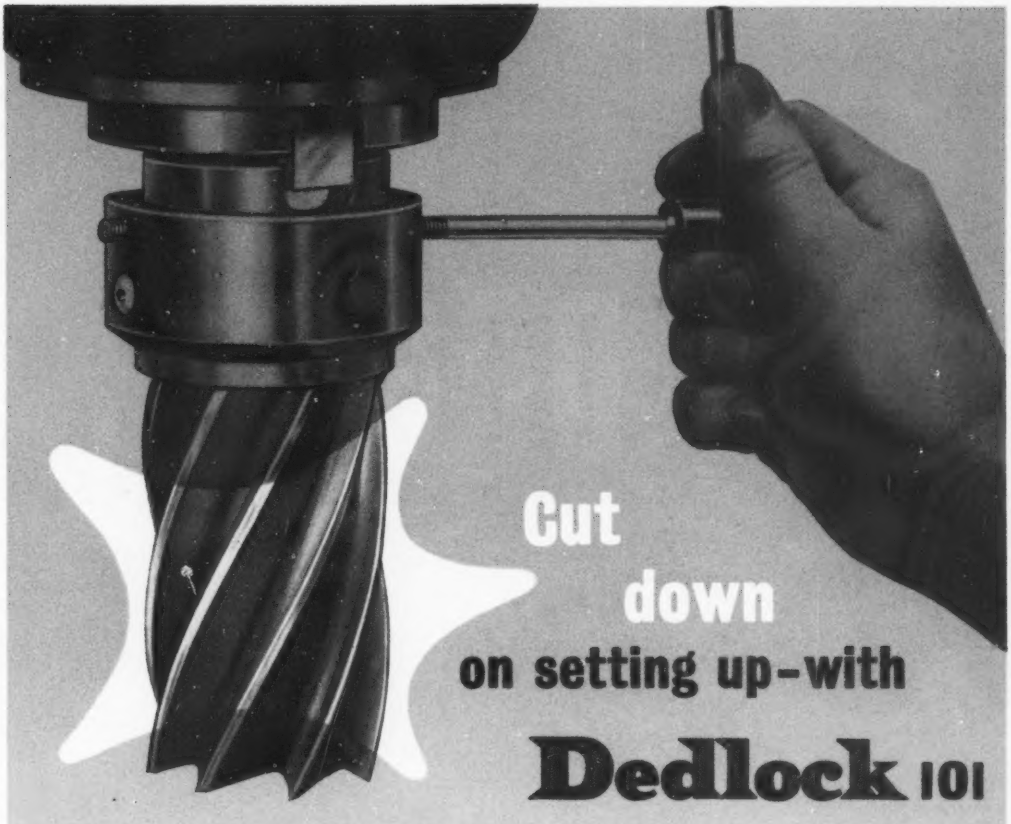
PRECISION *plus* PRODUCTION

C661



It takes only seconds to set-up Dedlock Cutters with perfect accuracy and rigidity, giving complete visibility of the work and eliminating overarm arbor supports. Moreover, Dedlock Cutters are made of the finest high speed steel, with teeth perfectly designed for long life. The amazing range of 2" to 6" diameters eliminates the need for costly and out-dated Shell End Mills, Face Mills, Large Taper Shank End Mills, and Cylindrical Cutters. The Dedlock principle "the heavier the cut, the tighter the grip" allows hitherto impossible working feeds and speeds. *Delivery by return from Clarkson depots—at maker's prices*

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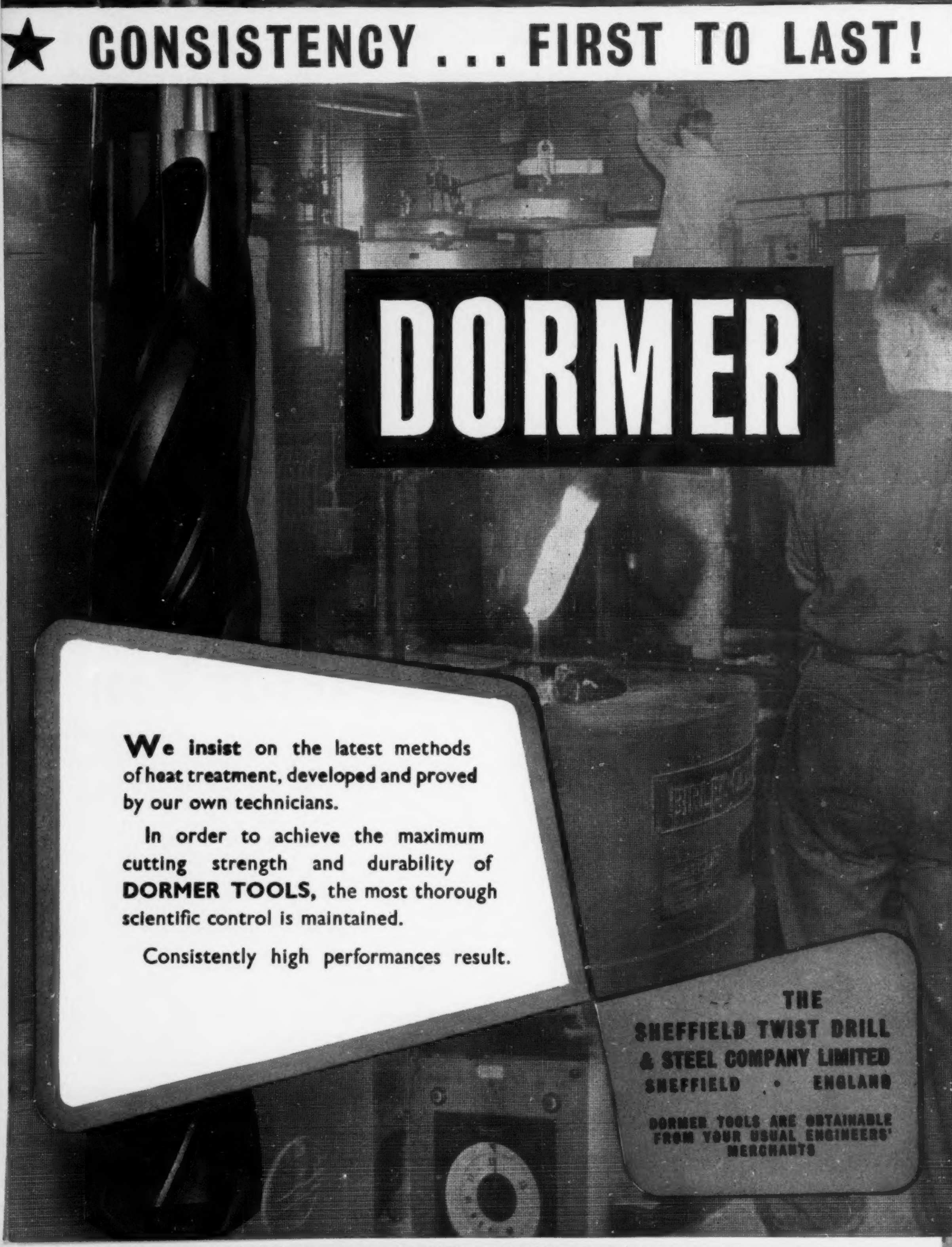
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DORMER
We insist on the latest methods of heat treatment, developed and proved by our own technicians.
In order to achieve the maximum cutting strength and durability of DORMER TOOLS, the most thorough scientific control is maintained.
Consistently high performances result.
THE SHEFFIELD TWIST DRILL & STEEL COMPANY LIMITED
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DORMER TOOLS ARE OBTAINABLE FROM YOUR USUAL ENGINEERS' MERCHANTS

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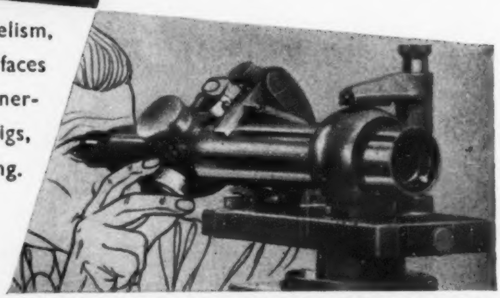
Micro Alignment Telescope

Set and check alignment, parallelism, squareness and generate plane surfaces of Diesel Engines, Turbines and Generators, Machine Tools, Aircraft Jigs, Nuclear Reactors by Optical Tooling.



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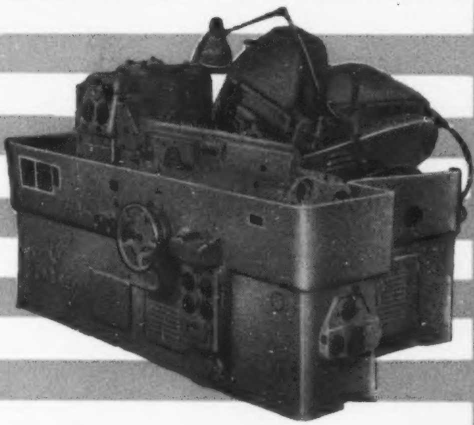


THE LINDNER WORM AND THREAD GRINDING MACHINE

Distance between centres ..	32in.
Maximum grinding length ..	20in.
Maximum grinding diameter ..	10in.
Maximum helix angle right and left	40°

External and internal grinding with single and multi-profile wheels.

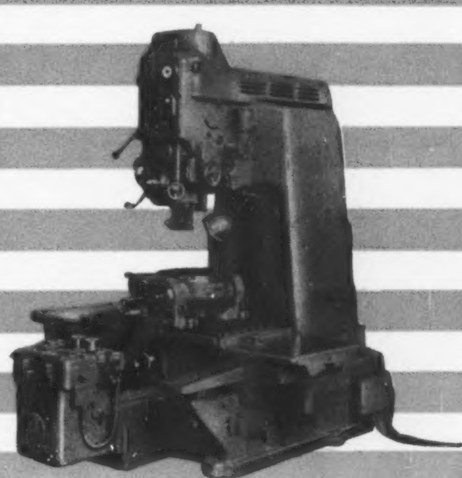
Automatic in-feed grinding.

Other models of thread grinders available for continuous thread up to 13ft.

LINDNER

THE LINDNER JIG BORER

- Optical adjustment
- Measuring system free from wear
- Pre-selection of adjustments
- Projection optics
- Open-front design
- Automatic locking and releasing of the co-ordinate table and boring head
- Centralized lubrication
- Setting accuracy 0·00004in.
- Spindle Speeds 25—1900 infinitely variable.



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the new

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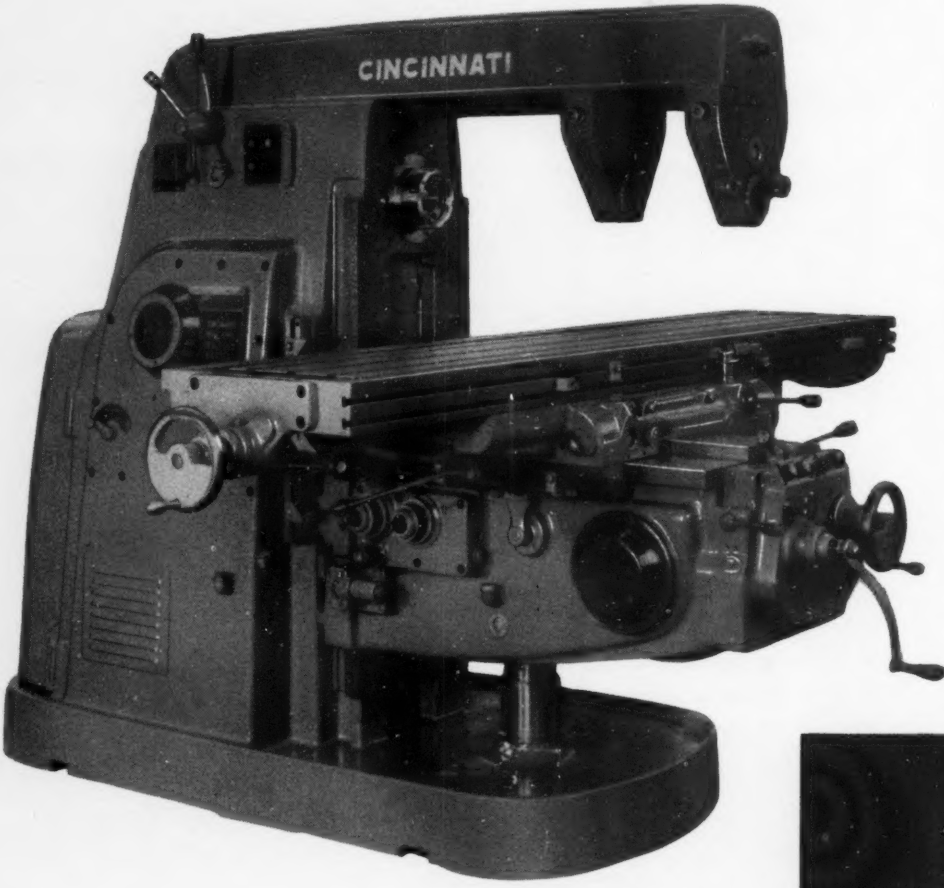
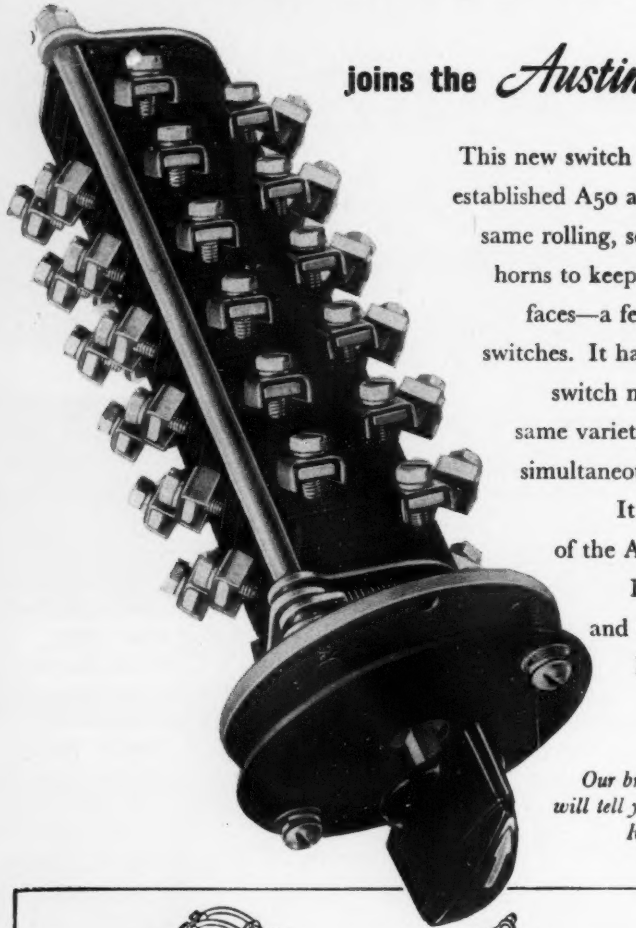


AGENTS

Chas. Churchill & Co. Ltd.
London, Birmingham, Manchester
Gateshead, Glasgow.

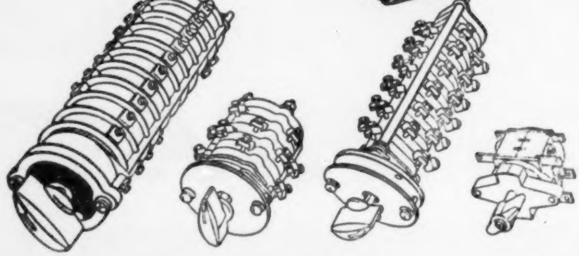
Now the A15—



joins the Austinlite rotary switches

This new switch is identical in principle to the well established A50 and A30 rotary switches. It has the same rolling, self-cleaning contacts with extended horns to keep any arcing away from the contact faces—a feature exclusive to Austinlite rotary switches. It has a similarly powerful and positive switch mechanism, and can be built in the same variety of forms to switch in sequence or simultaneously very large numbers of circuits. It is extremely compact, the smallest of the Austinlite multi-cell rotary switches. It bridges the gap between the A30 and the little single-cell 10-amp switch. Delivery, on standard applications, can now be made in four weeks.

Our brochure "SIMPLIFIED SWITCHING" will tell you more about the advantages of Austinlite Rotary Switches. May we send you a copy?



The four Austinlite Rotary Switches—A50, A30, A15 and A10

Austinlite

ROTARY SWITCHES

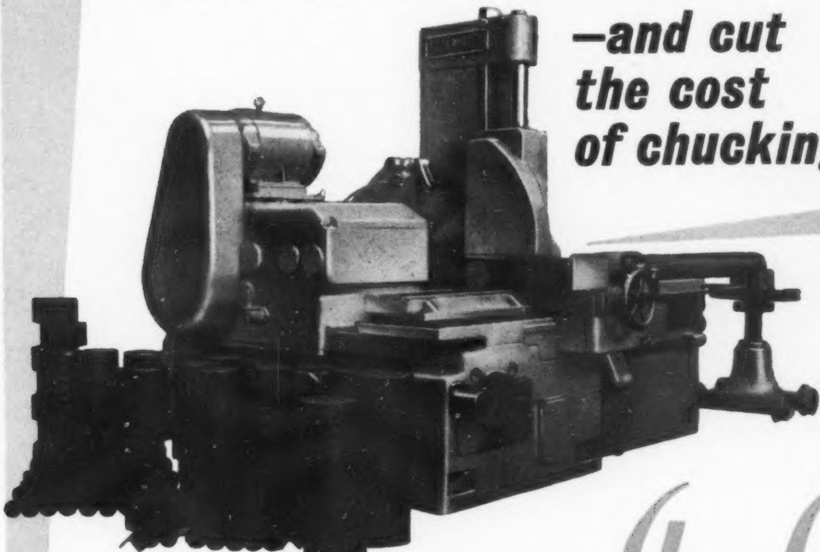
tailor-made by

STONE-CHANCE LTD.

(Makers of Sumo Pumps and Stone-Chance lighthouses). Crawley, Sussex

USE THE 'SLUG' TECHNIQUE

—and cut the cost of chucking work



Photograph shows various size steel blanks cut in six hours. One operator can work more than one machine, once setting-up and loading are completed. The cycle is automatic and even the swarf is collected in a bin.

NOBLE & LUND *fluifeed*

AUTOMATIC COLD SAW

MODEL AL/CC

28in. Size with chip conveyor — parts slugs from bars in a fraction of the normal lathe or automatic time

Close control of production times has proved without doubt that the use of pre-cut slugs on single spindle bar automatic and turret lathes can show savings of from 30 to 75 per cent.

The new FLUIFEED automatic cold saw has been specially developed to give production shops the full advantage of the 'slugging' technique, and really revolutionary production times are being recorded. We will gladly co-operate with you on your own work. Get in touch with us without delay.

FOUR SIZES OF THE 'FLUIFEED' AUTOMATIC

22in. ADMITS UP TO 7½in. DIAMETER.
28in. ADMITS UP TO 10in. DIAMETER.
38in. ADMITS UP TO 14in. DIAMETER.
48in. ADMITS UP TO 17in. DIAMETER.

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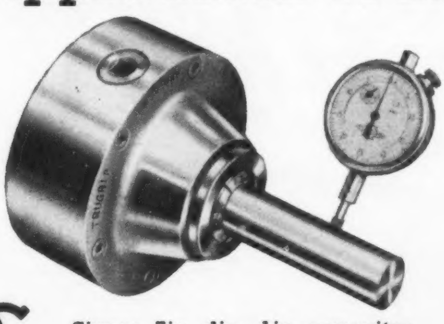
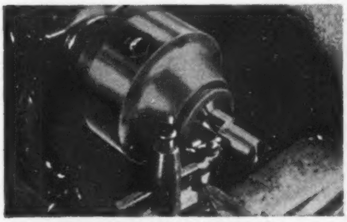
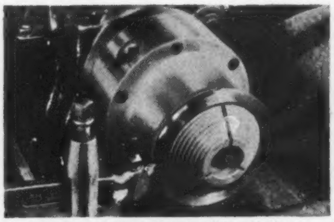


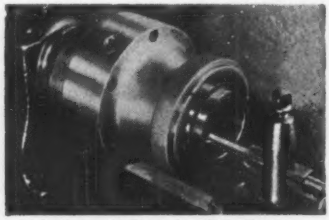
"TRUGRIP" COLLET CHUCK

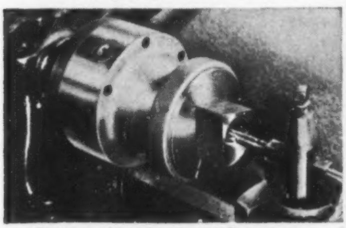
With the Crawford "Trugrip" Collet Chuck, work is held true, instantly, by the turn of a key. Absence of drawtube or sleeve means that full bore of spindle can be used. Powerful, positive action, with no distortion, and no marking of previously machined surfaces, makes it ideal for second operation work. Wide range of collets greatly increases capacity of machine, nine typical examples shown below.

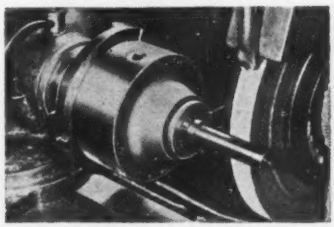
Sizes: 5in. dia., 1in. capacity; 7in. dia., 2in. capacity

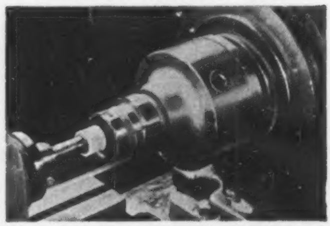

Turning using Standard Collet.

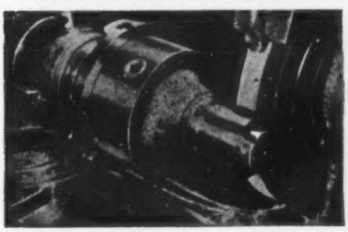

Facing and turning using Ring Collet.

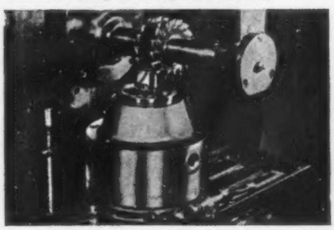

Facing and boring using Disc Collet.

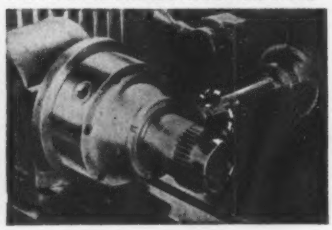

Boring an irregular shaped Component


Grinding using Standard Collet.


Internal grinding using Oversize Head Collet.


Grinding O.D. and face dead true with bore using Expanded Mandrel.


Milling on Index Fixture.


Milling on Expanded Mandrel.

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CONTENTS

Abstracts of Principal Articles

The Production of Ford Commercial Vehicles .... P. 920

For the Ford Thames Trader range of commercial vehicles, which includes units with carrying capacities up to 7 tons, a standardized rear axle design is employed, which is manufactured by efficient, quantity-production methods. For operations on the rear axle carrier casting, which provides bearings for the driving pinion and differential, only two machines are installed. On the first—a Ryder 6-spindle Verticalauto—rough turning and facing operations are performed and holes are drilled in the flange. The castings are then loaded into pallets on a 21-station Alfing in-line transfer machine, on which the driving pinion bores and faces are rough- and semi-finish machined and fine-bored, the bearing cap holding-down bolt holes are drilled and tapped, and the bearing caps are fitted manually, before rough- semi-finish- and finish-boring and threading are carried out. Features of interest on this machine include an arrangement for the return of the pallets on an overhead track, provision for turning the pallets so that operations on bores at 90 deg. to each other can be completed, and a shaping head which cuts V-shaped grooves to form chamfers at the edges of the bearing cap joint faces. The castings are unloaded and inspected at a gauging station equipped with a large receiver gauge for checking the relative positions of the bores, and pneumatic units for measuring diameters and ovality. (MACHINERY, 93—22/10/58.)

Typical Operations on Components for the Convair 880 Jet-propelled Air-liner P. 934

It is stated that the Convair Division of General Dynamics Corporation, U.S.A., has spent 22 million dollars in preparation for building the 880 jet-propelled air-liner, and, of this total, machine tools and associated equipment have accounted for nearly 4 million dollars. Some typical machines and operations are here discussed and it may be noted that advantage has been taken, where possible, of the facilities afforded by numerical control. An Onsrud spar mill, which is 105 ft. long, is available for operations on components up to 60 ft. long by 3 ft. wide and is arranged for both vertical and tilting movements of the cutter heads which are controlled by templates. Integrally stiffened skin panels are produced on a Giddings & Lewis skin mill with vertical and horizontal heads, on which all movements are controlled by the numericord system. There is also a Variax machine with a similar system arranged for controlling the cutter head about three axes. Other machines illustrated and briefly described include a Sundstrand profiler with a True-Trace hydraulic copying head; an Ekstrom-Carlson router; an Arrow profiler; and a Cyril Bath radial draw-former of 75 tons capacity. (MACHINERY, 93—22/10/58.)

Lost Wax Investment Casting ....P. 941

Certain developments and improvements have recently been made in connection with the Trucast method of lost wax investment casting. By using a "dual-gravity" refractory material, it has been possible to improve the strength of the mould, and the weight of metal which can be poured at one time has been increased to 30 lb. A new precoating material has been developed for the wax trees, to eliminate the type of surface defect known as "fusion," or "slag spots," which frequently occurs when casting chromium alloys of the martensitic type. The latest standard wax injection machine which has been designed and built allows wax models to be produced at the average rate of 4 per min. from a single impression die. Mention is made of the radio-frequency furnace which is employed exclusively for the Trucast process, and details are given of a number of instances where investment castings have been used in place of a part, or parts, which, hitherto, had been machined from the solid. Finally, a method of producing wax injection dies for turbine blades from strickled plaster moulds is discussed. (MACHINERY, 93—22/10/58.)

New B.M.C. Body Painting Plant... P. 950

The extensive programme of expansion that is being carried out by the British Motor Corporation includes a completely new body painting plant at the Cowley works of Morris Motors, Ltd., which has recently been brought into operation, and is stated to be one of the most efficiently-planned units of its kind. Two conveyorized paint lines are installed, each of which is capable of handling 26 bodies per hour. There is also a new Rotodip plant which augments existing facilities for applying the anti-rust treatment before the bodies pass to the paint lines. Features of the latter include fully-automatic spray booths, overhead stoving ovens to conserve space, and facilities for rapidly changing over to any one of 26 different paint colours in the finishing booths. (MACHINERY, 93—22/10/58.)

Contributions to MACHINERY

If you know of a more efficient way of designing a tool, gauge, fixture, or mechanism, machining or forming a metal component, heat treating, plating or enamelling, handling parts or material, building up an assembly, utilizing supplies, or laying out or organizing a department or a factory, send it to the Editor. Short comments upon published articles and letters on subjects concerning the metal-working industries are particularly welcome. Payment will be made for exclusive contributions.

IN FORTHCOMING ISSUES

Machining blades for gas turbine units—Safety arrangements for pressure die casting.

Ultrasonic Welding

The production engineer is called upon to provide strong, durable, permanent joints between the component metal or alloy parts of innumerable assemblies. These components differ very widely in characteristics, composition, and thickness, for example, and service requirements may be equally diverse and tend to become increasingly exacting. To enable the many problems that arise in this connection to be satisfactorily solved, a great deal of research work has been carried out in recent years, and there have been very important developments in such well-established processes as riveting; gas, resistance and arc welding; and brazing. As a result, the scope of these processes has been progressively extended, and the quality of joints obtainable has been improved. At the same time, other joining methods have been introduced and are proving very effective for certain applications. Among these newer methods, so far as the metal working industries are concerned, may be mentioned adhesive bonding, metal stitching, and cold pressure and ultrasonic welding.

As was explained in an article published recently in MACHINERY, aluminium, copper and most of their alloys, also high-purity lead, zinc, nickel, silver, palladium, platinum, and gold, can be pressure welded in the cold state. It is interesting to note, moreover, that a joint may be obtained by this method between two pieces of the same metal, or between pieces of any two different metals, of those listed. Sheet or foil may be joined by lap welding, and strip, wire or rod by butt welding. It is also possible to seal "cans" by cold ring or extrusion welding. In lap welding, some restrictions are imposed by the fact that the finished thickness at the point of welding is drastically reduced, and for this reason, a wavy weld line may be preferable to a straight line.

Ultrasonic welding, to which brief reference has previously been made in MACHINERY, is the latest of the processes mentioned, but according to information presented by Mr. J. Byron Jones and Mr. W. C. Potthoff during the course of a paper read recently before the American Society of Tool Engineers, there have already been rapid advances in this field. With the ultrasonic process, it may be recalled, the components to be joined are held in contact under comparatively light pressure, and are subjected to high frequency vibration, which causes the surfaces to weld together. As an indication of the progress that has been made, it is stated that in 1955 Alclad aluminium alloy sheet could not be welded ultrasonically. In 1956 it proved possible to spot weld 0·040-in. thick sheet, but the strength of the welds barely met specification requirements. By 1957, spot welds were being produced in 0·063-in. sheet with a strength considerably in excess of that specified, and early this year, the thickness which can be successfully welded was raised to 0·090 in.

These results, which have enabled the range of application of the process to be greatly extended, have been achieved by introducing improved transducer-coupling systems to enable more energy to be delivered to the weld zones, and by providing equipment for spot welding operations with capacities up to 8 kW. It has been found that ultrasonic welding can be performed over a broad frequency band, but attention has been directed to the development of equipment for operating in the range from 3,000 to 85,000 cycles per sec. The transducers employed incorporate stacks of thin-gauge nickel sheet, and it is pointed out that the coupling system employed must be force-insensitive. In other words, there must be no significant shift in the resonant frequency of the system when pressure is applied to the work.

Joints may be formed by single spots or by overlapping spots, the latter being obtained without difficulty since no electric current flows through the joints. It has been found that welds can be located close to the edge of the material without loss of spot strength, and it is therefore possible to reduce the amount of overlap. More recently, roller type ultrasonic welders have been introduced for producing continuous seams. With this method, the work may be passed between rotating rollers, one or both of which may form part of a transducer coupling system, or it may be supported on a table and traversed beneath a single roller.

It may be of interest to mention a few recent applications of ultrasonic welding as an indication of some of the problems that have been solved in this way. In one instance, a platinum-alloy resistance wire of 0·0015 in. diameter is welded across two copper lead wires, and sound mechanical joints, with consistent electrical resistance, are obtained. Another delicate operation involved the welding of two thicknesses of etched stainless steel

(*Continued on page* 970)

The Production of Ford Commercial Vehicles

Transfer Machining of Rear Axle Carriers for the Thames Trader Range

The recently-introduced range of Ford Thames Trader commercial vehicles includes types with rated carrying capacities of 1½, 2, 3, 4, 5, and 7 tons, and they can be supplied with a variety of bodies, including normal lorry and other designs, one of the latter being seen in the heading illustration. Several chassis lengths are offered, so that the most suitable wheel-base can be selected when special bodies are to be built for the carriage of particular kinds of goods. Power is provided by 4-cylinder engines for sizes up to 5 tons capacity, alternative petrol and Ford-built diesel units being available. Larger-capacity vehicles are powered by 6-cylinder engines, also in petrol and diesel types, and the ranges of engines have many components in common so that they may be produced by efficient methods.

Features of the engines include 5- and 7-bearing crank- and cam-shafts, and wet-liners which permit the use of long-wearing material for the cylinder walls, and are easily replaced, when necessary, instead of being re-bored. Radiator thermostats are fitted to ensure that the engines operate at optimum temperatures, and corrugated steel cylinder head gaskets are fitted. The diesel engines are designed for easy starting and low fuel consumption, and it is claimed that the four-hole injector nozzles employed ensure efficient combustion. With the 6-cylinder engine, 100 h.p. is generated at 2,500 r.p.m., and the maximum torque of 242 lb.-ft. is obtained at 1,500 r.p.m. The petrol engines are of modern design, with wedge-shaped combustion chambers and overhead valves inclined at an angle of 13 deg. to the vertical, and the 6-cylinder unit develops 110 h.p. at a speed of 2,800 r.p.m.

Each vehicle in the range is fitted with a 4-forward speed, synchromesh gearbox, which has provision for power take-off, and the gearbox is so installed that it can be removed without disturbing the engine. The drive is transmitted through hypoid bevel gearing in the rear axle, and the bevel gear and pinion, together with the differential, are housed in a one-piece carrier of cast iron. The carrier, the machining of which forms the subject of this article, is housed in a banjo-shaped axle casing, and can be removed as a whole when servicing is required. Certain vehicles can be supplied with the Eaton 2-speed axle, and this unit is accommodated in the standard banjo housing, so that the minimum of extra cost is incurred. Other features of the range include servo-assisted hydraulic brakes and worm and roller steering.

The rear axle carrier casting, which is of grey iron, is shown in section and elevation in Fig. 1, and it will be seen that there is a main bore *A*, which accommodates the bearing for the outer end of the driving pinion shaft, and a smaller bore *B*, in a boss supported by projections and webs on the casting, for the inner end. At 90 deg. to the common axis of these bores, there are two other bores, formed half in the carrier casting and half

in two bearing caps attached to it by means of hexagon-headed bolts, the casting portion of one bore being indicated at *C*. These two bores provide housings for the bearings of the differential carrier, and in addition to being accurately machined, must be threaded at their outer ends.

OPERATIONS ON RYDER VERTICALAUTO

The preliminary operations on the casting are performed on a Ryder No. 10, 6-spindle, Verticalauto, and a view of this machine is given in Fig. 2. Driven by a main motor of 60 h.p., this machine is employed for several turning and facing operations, notably on the casting flange, and for drilling a total of 14 holes in the flange, of which two, indicated at *D*, Fig. 1, serve for location purposes throughout the remainder of the machining sequence. Rough castings, which weigh about 65 lb., are supplied in clean condition and painted to prevent rusting during storage, and they are loaded at the centre position in Fig. 2. Here, each casting is placed, by means of a hoist, with the outer face of the flange (in the final assembly) facing downwards and resting on three equally-spaced tapered pins, as at *E*, on which it is supported at the correct height in relation to the cutting tools.

Angular location of the casting, for the final drilling operation, is taken from two cast bosses *F*, Fig. 1, on the underside, which are engaged by a sliding latch carried on the top surface of the steel block *G*, Fig. 2. This latch is spring-loaded towards the casting, and has a wedge-shaped end which enters the space between the bosses. Near the centre of the chuck there is a projecting stud with a nut, over which the pinion bore is passed when the casting is loaded, and a C-washer is fitted to this stud and the nut tightened, for initial clamping. Three hydraulically-operated jaws on the chuck are then tightened, to a controlled pressure, by moving the ball-ended handle *H*, on the machine base, and the automatic cycle is started by means of another lever *J*, above the operator's head.

The table indexes to the left at the beginning of the machine cycle, and the horizontal slide at the first machining station is equipped with two carbide-tipped tools, which provide for rough facing the flange and the upper ends of the pillars *K*, Fig. 1, to which the bearing caps are later attached. A vertical slide also carries two tools, which are fed down to rough turn the outside surfaces of the pillars and the main spigot diameter *L*, Fig. 1. At the second machining station, the tools are similarly disposed, and perform semi-finishing operations on the surfaces mentioned. Only one tool—on the vertical slide—is applied at the third station, to form a 0·04-in., 45-deg., chamfer at the edge of the spigot. At station

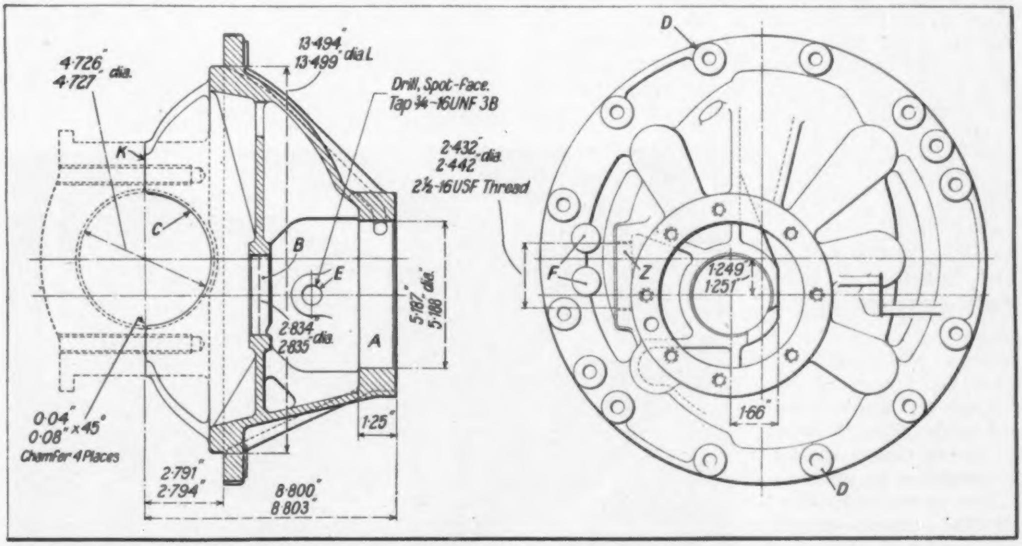


Fig. 1. The rear axle carrier casting for the Ford Thames Trader range of commercial vehicles is here shown in section and elevation

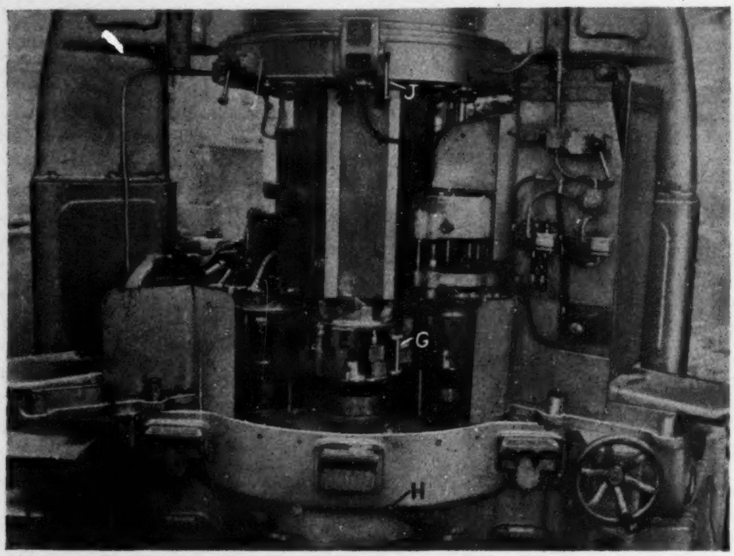


Fig. 2. For the first series of operations on the rear axle carrier casting, this set-up, on a Ryder 6-spindle Verticalauto, is employed, and provides for rough-turning and -facing, also drilling operations

four, there are two tools on the horizontal slide, which serve to finish the spigot diameter *L*, Fig. 1, to 13·494/13·499 in., also to finish face the flange and the ends of the bearing cap pillars *K*.

For all these operations, the tools are tipped with Wimet grade N tungsten carbide, and the cutting speeds range up to 250 ft. per min. Feed rates from 45 to 134 cuts per in. are employed, and the maximum depth of cut is approximately $\frac{1}{8}$ in. At the last station, which is seen at the right in Fig. 2, there is a column on the horizontal slide for a Mulhead 14-spindle drill head. This head is driven, at a speed of 387 r.p.m., by a vertical shaft, from the mechanism at the top of the central portion of the machine. At this station, the spindle is automatically turned, until a pawl on the chuck base comes into contact with a stop on the column, to position the casting correctly in relation to the drills, and the spindle is then locked. The head is next fed down to drill two holes of [illegible] and 12 holes of 0·464/0·474 in. diameter, and is then raised automatically in readiness for indexing. These operations are completed in a floor-to-floor time of 3·9 min.

ALFING 21-STATION IN-LINE TRANSFER MACHINE

All the remaining operations on the rear axle carrier casting are performed on an Alfing (Associated Alfing Kessler, Ltd.), 21-station, in-line automatic transfer machine, a general view of which is given in Fig. 3. Of the platen type, this machine is more than 100 ft. long and has 14

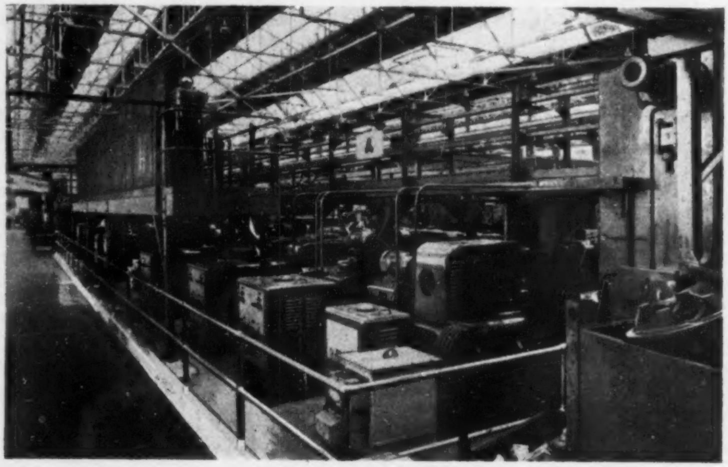


Fig. 3. A general view of the Alfing 21-station in-line transfer machine employed for operations on the rear axle carrier. The cabinets opposite each head contain hydraulic pumps and control valves

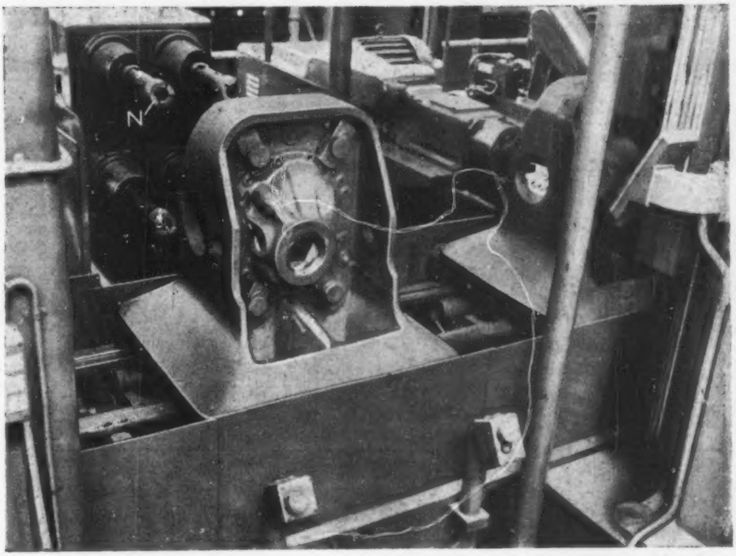


Fig. 4. Close-up view of the loading station on the Alfing machine showing the platen in which the casting is supported with the main flange vertical. Clamping is performed semi-automatically by the head on the far side of the machine and the pallets travel towards the right

working stations with a total of 87 spindles. The platens, which are square in plan, travel from the loading end of the machine, at the right in Fig. 3, towards the far end, and are turned through 90 deg. just after passing the half-way point, to enable the machining operations to be completed. At the far end of the machine, the platens are returned to their original position for unloading, and are moved on to a platform, whereon they are raised to the level of the overhead return track shown. A chain type conveyor then moves the platens back to the loading end, where they are lowered to the transfer track level, ready to pass through the machine again.

All the electrical switchgear is contained in a row of cabinets which are installed above the level of the machine, on a platform constructed from angle- and channel-section steel, where they are out of the way yet readily accessible. The movements of the machine heads, which are hydraulically powered, are controlled by mechanisms within the cabinets at each side, one cabinet serving one or more heads, depending on the complication of the operations performed. Hydraulic pressure for the movement of each head is supplied by a pump which is continuously driven by its own motor. The pump spindle extends beyond the pump housing to another pump, the drive being transmitted through an electro-magnetic clutch. Oil delivered by the constantly-driven pump serves for the slow feed motions of the head, and is passed through restrictor and directional control valves operated by knobs on the outside of the cabinet. When the rapid advance or withdrawal motion is required, the electro-magnetic clutch is engaged to drive the second pump, and the extra oil thus supplied is passed to the feed cylinder to increase the speed of movement.

Since the distance between adjacent machining station is considerable, the platen bases measuring about 30 in. square, the transfer bar must make a fairly large movement, and it is operated by means of two long-stroke hydraulic cylinders, one at each end of the machine bed, which are supported on substantial outrigger brackets. The cylindrical bar is provided with ears at the positions adjacent to the machining stations, and is turned, by means of a transverse cylinder, to engage these ears with the platens in readiness for each transfer motion. Further reference to this cylinder, and the transfer motion, will be made later. Each platen rests on the surfaces of a location track at the machining and idle stations, but at the intermediate positions it travels on a separate transfer track.

The under-side of each platen is provided with a roller at each corner, which rests on the transfer track. At the machining and idle stations, the rollers enter gaps in the track, and the platen drops approximately 0·010 in. on to the location track. Wear of the location surfaces is thus minimized. At each station, the platen is located by two dowels of about 2½ in. diameter, with chamfered edges to facilitate entry, and is clamped at each corner, the dowels and the clamps being operated by two hydraulic cylinders at each position. Semi-automatic mechanisms are provided for clamping and unclamping the component

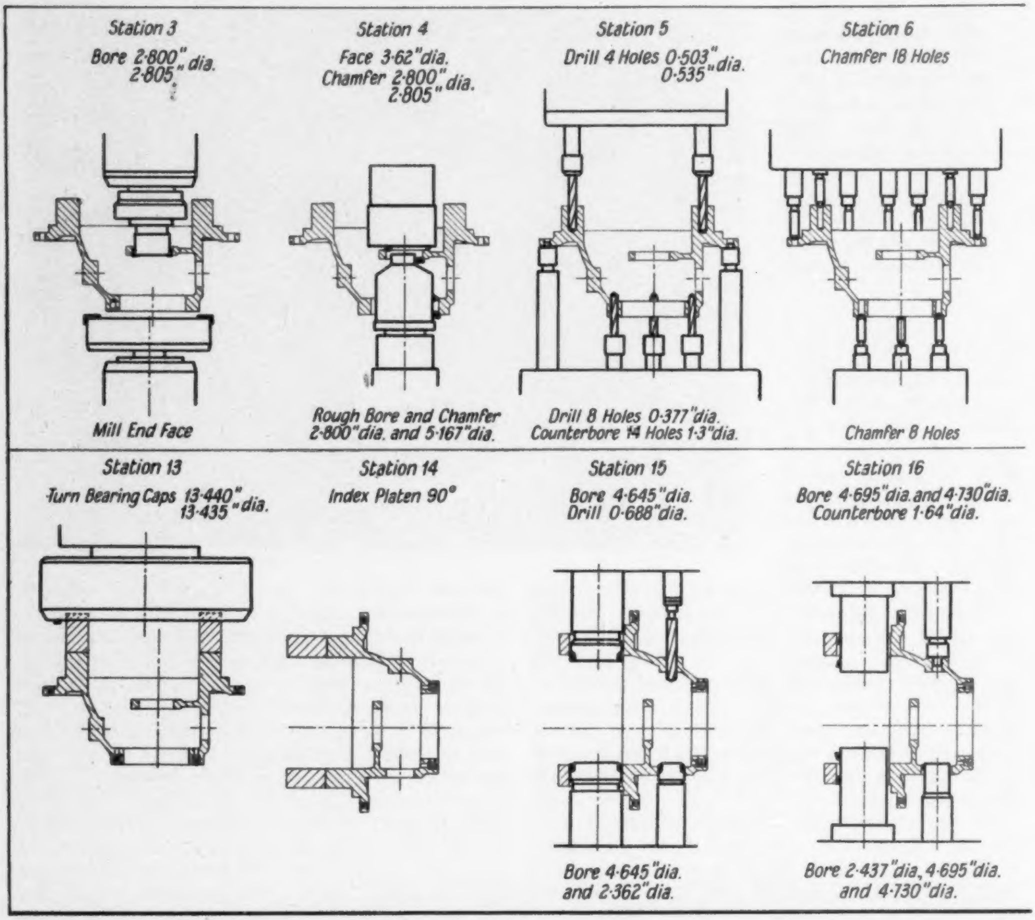
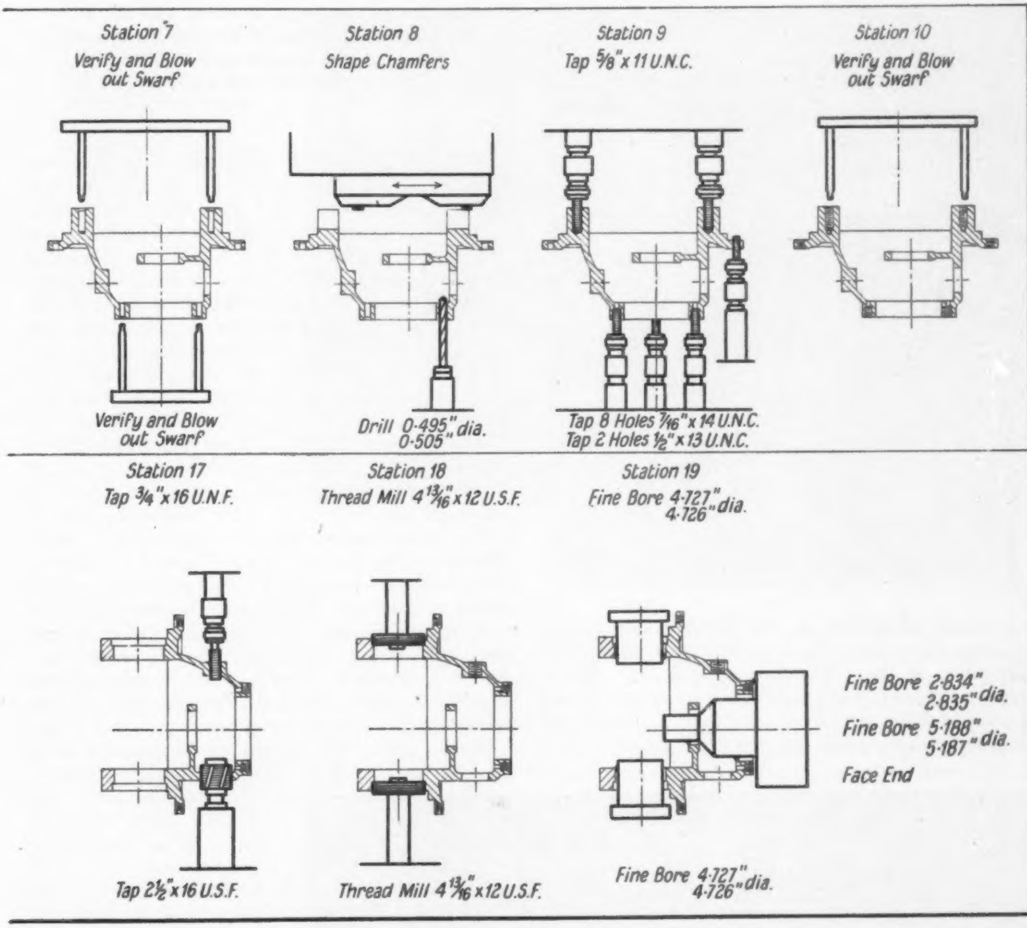


Fig. 5. In this lay-out of the stations on the Alfing machine, those which are idle, or are employed for fitting bearing caps, and for loading or unloading, have been omitted for clarity

at each end of the machine, and the equipment at the loading station is seen in Fig. 4, which is a view from the side opposite to that seen in Fig. 3.

Empty platens progress from the platform of the lowering unit at the left in Fig. 4, the housing of which can just be seen, along the transfer track to the loading station, designated No. 2. A casting from the Ryder machine is loaded by hand—although a hoist was originally provided—being placed initially on the central rib of the platen base and turned until the face *M* is in a vertical position at the left. The casting is next raised until its flange face is almost vertical and the lower edge of the spigot is resting in a register hole in the vertical wall of the platen. In this position, the lower of two locating dowels can be engaged with the corresponding hole of the two marked *D* in Fig. 1, and the casting is then pressed forward to engage the other hole with its dowel and to carry the flange into contact with four pressure pads on the vertical face of the platen.

Holding the casting in place with one hand, the operator next turns the four clamping pads through about 90 deg., to overlap the flange and hold the casting in position while it is being clamped. Each clamping pad is attached to a bolt which extends through the fixture and has a special nut on the



opposite side, as may be seen in Fig. 12. The nut is of cylindrical form, and is cut away at the outer end to leave two projections whereby it can be engaged and turned by a spanner of similar shape. A unit head on the opposite side of the machine at this station is equipped with four spindles, each of which carries a spanner of this type, as at *N* (Fig. 4), and when the two widely-spaced buttons in the foreground are depressed, the head is advanced into the clamp-tightening position.

Each spindle is then driven, first to engage the spanners with the nuts, and then to tighten them, and the drive to each spindle is transmitted through a torque-limiting clutch so that only a pre-determined clamping pressure can be applied. As soon as the nuts have been tightened the spindles are stopped and the direction of the oil supply to the traversing cylinder is automatically reversed. The head is then withdrawn, leaving the pallet ready for the next indexing motion of the machine. This motion is selected by the operator, as soon as the clamping sequence has been completed, by pressing a button on an adjacent panel, from which the entire machine can be controlled. Lights on this panel are illuminated to show the positions of all the heads on the machine, so that the tracing of any faults is facilitated and the completion of the operation cycle is indicated.

MACHINING OPERATIONS

The complete sequence of operations carried out on the Alfing machine includes rough- and semi-finishing the driving pinion bores and faces,

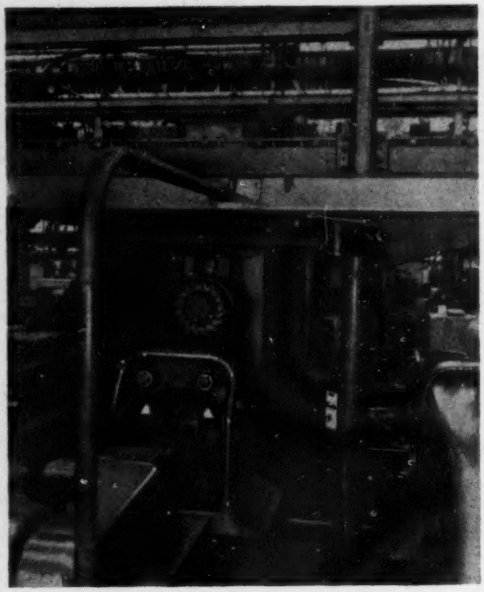


Fig. 6. Station No. 3, here seen from the left-hand side of the machine as viewed in the direction of platen-transfer, provides for milling the pinion boss and boring the small bore *B*, Fig. 1

machining chamfers on the bearing cap pillars, drilling, spot-facing where necessary, tapping, and assembly of the bearing caps by hand. Subsequently, the castings are turned, as mentioned earlier, before the differential bearing bores are finished and threaded, and the driving pinion bores and faces are finished. This sequence of operations is shown diagrammatically in Fig. 5, from which an idle station, and those for platen raising and lowering, bearing cap fitting, and work loading and unloading, (numbered 1, 2, 11, 12, 20 and 21) have been omitted for clarity. From this diagram, it will be noted that there is a head at each side at the first machining station—No. 3—which can also partly be seen at the right in Fig. 4.

Henceforth, references to the right- and left-hand sides of the machine will assume that it is viewed from the loading end in the direction of platen movement. The head at the right at station No. 3 is the only vertically moving unit on the machine, and is seen in the view from the left-hand side, in Fig. 6. This head has a vertical slide, which carries an 8-in. diameter Galtona (Richard Lloyd, Ltd.) cutter with 16 inserted carbide-tipped blades. Driven at 76 r.p.m., this cutter operates on the outer face surrounding the driving pinion bore, at a feed of 0·126 in. per rev., and leaves about 0·010 in. of stock for a finishing operation. The horizontally-moving head at the left-hand side of the machine, seen in the foreground in Fig. 6, is equipped with a 4-bladed Galtona cutter for rough machining the inner pinion bore, *B* Fig. 1, about 0·060 in. on diameter being left for removal at subsequent operations.

Tools in the right- and left-hand heads at station 4 perform operations on the large and small pinion bores, respectively, and a view of this station, from the

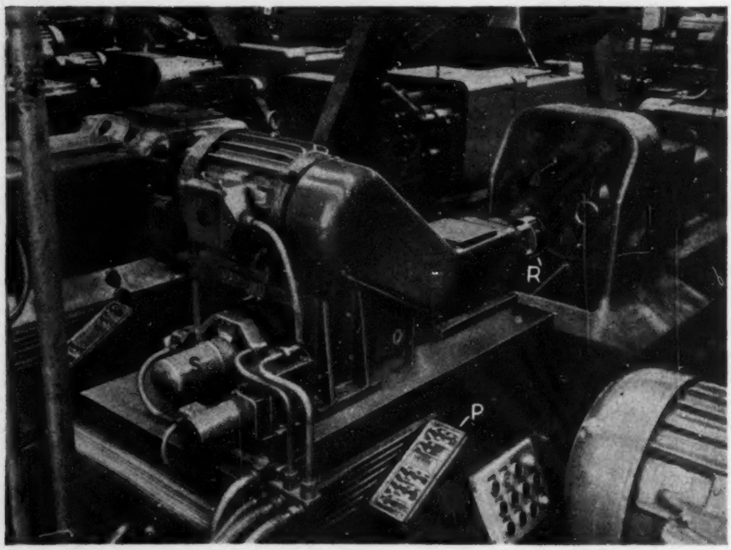


Fig. 7. The left-hand head at station No. 4 is designed for rough- and finish-machining the face surrounding the bore *B*, Fig. 1, and chamfering the end of the bore, and has two hydraulically-operated facing slides

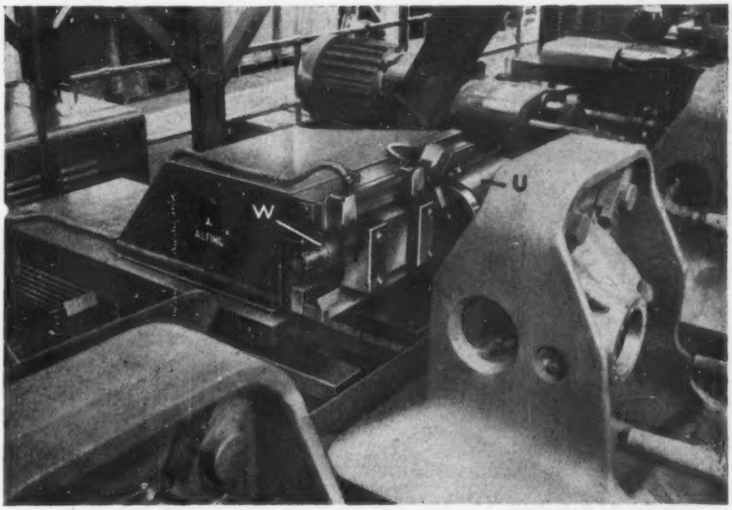


Fig. 8. Four V-section grooves are cut in the faces of the bearing cap pillars by tools in a horizontally-moving slide on the left-hand head at station No. 8. The slide is moved by the large hydraulic cylinder *U*

left-hand side of the machine, is given in Fig. 7. Here it may be noted that the movements of all the heads on the machine are controlled by the standard Alfing system. An inclined box *P*, one surface of which is formed of transparent plastics material, encloses a row of micro-switches connected to relays for controlling solenoid-operated valves in the hydraulic circuits. The plungers of these switches are depressed by adjustable dogs on a multi-grooved plate attached to the moving portion of the spindle head, so that, as the head advances, the switches are operated in succession. Another point of interest is that all the slideways are protected by concertina-type covers, also of transparent plastics material.

The right-hand head at station 4, at the far side of the machine in Fig. 7, has only one spindle, which is fitted with four single point tools for semi-finish boring and chamfering the outer ends of the two driving pinion bores *A* and *B*, Fig. 1, 0·015 to 0·020 in. being left on the diameters for removal at a finishing operation. A special facing unit, carried by the left-hand head at this position, incorporates a holder *R*, of cylindrical form. Within this holder there are two slides, each with provision for holding two tools, which can be moved at right angles to the spindle axis by means of a cam mechanism. This mechanism is operated by a hydraulic cylinder which is mounted co-axially with the spindle at the outer end. The ram of this cylinder is connected to the cam mechanism by a drawbar, and it extends into the sheet metal cover S. Adjustable stops, carried by the ram, serve to operate micro-switches when it reaches the limits of its travel in either direction, and the next movement in the sequence is thus initiated.

At the beginning of the cycle, the head is advanced, first rapidly and then at a slow traverse rate, up to a stop, and the facing tool-holders, which move in opposite directions, are then brought into operation. One tool-holder carries a single tool, which takes a roughing cut across the left-hand face of the boss surrounding the bore *B*, Fig. 1. The other holder is equipped with two tools, one of which provides for finishing this face and is set slightly behind the roughing tool. Finally, the second tool in this holder cuts the chamfer at the left-hand end of the bore, and the head is retracted to avoid interference with the boring bar of the right-hand head, the tool-holders being automatically returned to their central positions. The facing spindle is driven at 270 r.p.m. and the tools are fed outwards at the rate of 0·0039 in. per rev. For plain boring operations, such as that performed by the right-hand head, cutting speeds of the order of 200 ft. per min. are employed, and the feed rate, in this instance, is 0·0059 in. per rev.

As indicated in Fig. 5, the next station (No. 5) provides for drilling the four holes in the pillars, which are later tapped for the reception of the bearing cap bolts, drilling eight holes in the pinion bore end face, and spot-facing the 14 holes previously drilled in the flange on the Ryder machine. Station No. 6 is equipped for chamfering the flange holes on the opposite side, also the pillar holes, and the eight holes surrounding the pinion bore, and at station No. 7, there are blow-out heads on both sides, which advance probes into the holes to ensure that they have been drilled to full depth, and clear them of swarf in readiness for tapping. A single spindle in the right-hand head at station No. 8 provides for drilling a hole of 0·495/0·505 in. diameter which is located adjacent to the outer pinion bore in the end face.

Fig. 9. At station No. 11, which is omitted from the lay-out in Fig. 5, the bearing caps are fitted, and the holding-down bolts are tightened to a predetermined torque by means of a King Dick spanner

CHAMFER-SHAPING HEAD

The left-hand head at station No. 8, which is of unusual design, is employed for cutting V-shaped grooves in the faces *K*, Fig. 1, of the pillars which carries the bearing caps. Each groove centre line coincides with the bore when it is machined later in the sequence, and half of each groove is thus removed, leaving a chamfered edge on each side of the bore, as indicated in Fig. 1. A close-up view of the head in question, taken from the right-hand side of the machine, is given in Fig. 8. There is a horizontal slide *T*, which is guided in square-section ways and carries four carbide-tipped tools, shaped to an included angle of 90 deg. Each tool is employed to cut one of the grooves mentioned when the head has been fed to a fixed stop, and the large-diameter horizontal cylinder, partly seen at *U*, is energized.

The ram of this cylinder has a rounded end, and is not attached to the slide but merely pushes on its end surface so that it is moved past the face of the casting. At the end of the stroke of the large cylinder, the ram is retracted to the position shown and the head is withdrawn. Another, smaller cylinder *W*, mounted horizontally in a recess between the head casting and the slide, is then employed to return the slide to the right, ready for the next grooving operation. A head on the right at station No. 9, equipped with four spindles, taps the holes in the bearing cap pillars ⅝ in. by 11 U.N.C. 3B. The head at the left has 14 spindles which are employed to tap 2 holes ½ in. by 13 U.N.C. 3B, and 12 holes $\frac{7}{16}$ in. by 14 U.N.C. 3B. Tapping is carried out at a cutting speed of about 15 ft. per min. under lead screw control. Station No. 10 has a head at the left-hand side only, which carries four probes for checking and blowing out the pillar holes in readiness for fitting the bearing caps.

Bearing caps are fitted at station No. 11, as shown in Fig. 9, the operation being carried out at the left-hand side of the machine. The caps are supplied in box pallets from another line, on which they are machined on the joint faces, drilled and spot-faced. A hole of about ¼ in. diameter is also drilled in each joint face, for the reception of a dowel pin with a hardened cone-shaped end. The point of the cone on each pin projects slightly above the surface of the joint face, and when the cap is fitted in position, and the holding-down bolts tightened, the pointed end is forced into the opposing face of the main casting. In this manner, a location is provided for each cap, so that it may be replaced in exactly the same position that it occupied during the final machining operations, after the differential assembly has been fitted.

Holding-down bolts for the caps are tightened with the aid of an Abingdon King Dick torque spanner, which is set to apply a torque of about 110 ft.-lb. to the ⅝-in. diameter bolts. The right-hand side of the machine at this station is idle, and indexing for the next cycle will not take place unless the fitter depresses a push-button to signal that the assembly of the bearing caps has been completed. Between stations No. 11 and 12 is installed the mechanism for turning the transfer bar to engage the ears with the platens. This mechanism comprises two horizontal hydraulic cylinders, one on each side of the machine, the cylinder on the right-hand side being seen in Fig. 10. The ram of each cylinder is connected to one of two swivelling brackets, hinged at a level below that of the transfer bar *X*, to the underside of which a long cylindrical projection is welded.

This projection is slightly longer than the total travel of the bar during the transfer motion, and it is engaged by jaws on both the brackets mentioned. At the start of the transfer cycle, the bar is in the position shown, and it is first moved to the left until each ear *Y*, is on the other side of the platen which it is to move. One of the transverse cylinders is then energized to turn the bar slightly, so that the ears are engaged with the platens, and the bar is then returned to the right, moving all the platens along, through the distance

between machine stations. Reference to the function of the second transverse cylinder will be made later, in connection with station No. 19 and 20. Station No. 12, at the right in Fig. 10, is idle, and is not shown in the sequence diagram, Fig. 5.

At station No. 13, the right-hand side of the machine is idle, and on the left-hand side there is a head with a single spindle, on which is mounted a large-diameter turning head. A view of this head, from the right-hand side of the machine, is given in Fig. 11, and it carries three tools of which two can here be seen. These tools are employed to machine the outside surfaces of the bearing caps, on which there are narrow cast projections, to a diameter of 13·435/13·440 in. Two of the tools share the rough-machining, and are set slightly in advance of the third tool which takes a light finishing cut. The spindle is driven at a speed of 56 r.p.m. to obtain the cutting speed of 200 ft. per min., mentioned previously, and the feed is 0·0079 in. per rev. A somewhat longer hydraulic cylinder and special valves are provided for this head, so that it may be withdrawn under manual control for a distance greater than is required for normal operation, for convenience in changing and adjusting the tools.

From Fig. 11, it may be seen that the remaining

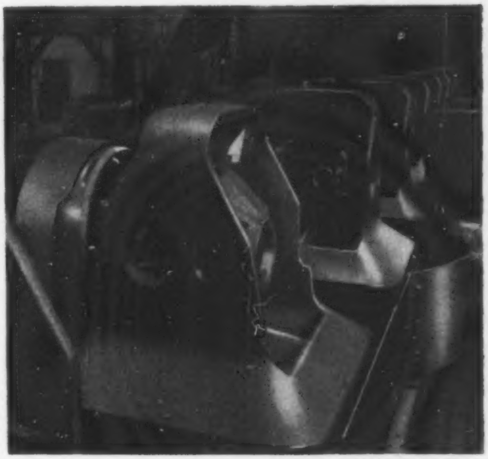


Fig. 11. The outside surfaces of the bearing caps are turned by three tools in a head at the left-hand side of station No. 13, and at the next station the platen is turned through 90 deg.

Fig. 10. Between stations No. 11 and 12, this mechanism is installed for partially rotating the transfer bar to engage the ears *Y* with the platens before the bar is moved longitudinally for the indexing operation

platens on the machine have been turned through 90 deg., to enable operations to be performed on the differential bearing bores, and this turning is effected at the next station (No. 14). Here, the platen is raised on a table, by means of two vertical hydraulic cylinders within the machine base, to a level at which it clears the surrounding machine surfaces and the transfer bar. The table is slowly turned through 90 deg., in an anti-clockwise direction as viewed from above, by a horizontal cylinder operating through a rack and pinion, and is then lowered to return the platen to the transfer track. The next machining station (No. 15) has a head on each side, and each head is equipped with a large and a small diameter spindle.

The larger spindle on each head is fitted with a Galtona cutter having eight inserted carbide-tipped blades, and these cutters are employed for roughing the bearing bores to 4·64/4·65 in., about 0·080 in. being left on the diameter for removal at later operations. In the smaller spindle of the right-hand head is mounted a 4-bladed Galtona cutter which rough machines the bore Z, Fig. 1, cored in the flat wall of the casting, to a diameter of 2·37/2·38 in. A drill in the second spindle of the left-hand head produces a hole of 0·687/0·692 in. diameter in the opposite side of the casting, as indicated at *E*, Fig. 1. Both heads are fed at 0·060 in. per rev.

Similar spindle combinations are provided on the

heads at each side of the next station (No. 16) at which the bore Z, Fig. 1, is semi-finished and chamfered and the bore *E* is spot-faced and chamfered. Each of the two larger spindles at this station has three single-point tools for semi-finishing operations on the differential bearing bores. One of the three tools serves to machine the bore to 4·695/4·700 in., leaving about 0·025 in. on the diameter for finishing, a second tool enlarges the end of the bore which is to be threaded, to 4·730/4·735 in., and the third produces a slight counterbore at the outer end. The two bores Z and *E*, Fig. 1, are tapped at station No. 17, to $2\frac{1}{8}$-in. by 16 U.S.F., and $\frac{3}{4}$-in. by 16 U.N.F. 3B, respectively, and the castings then reach station No. 18 at which the $4\frac{15}{16}$-in by 12 U.S.F. threads are milled in the bearing bores.

A close-up view of station No. 18 is given in Fig. 12, which shows the planetary type thread-milling heads fitted to both the right- and left-hand spindles. These heads are fed towards the casting, to advance the cutters into the bores, until the movements are arrested by fixed stops. The portion of each head carrying the spindle and cutter is then turned to feed the cutter into the work to the required depth, and the spindle housing is then rotated through one complete revolution to cut the threads. During this rotation, the cutter spindles are also cam-fed forward by a distance corresponding to one pitch of the thread. At the end of the milling operation the cutters are returned to the central position, and the heads are retracted. Each spindle is driven at a speed of 64 r.p.m. and the rotary feed is 0·094 in. per rev. of the cutter, the total cutting time being slightly more than 2 min.

FINE-BORING AND FACING OPERATIONS

The final operations on the casting, carried out at station No. 19, include fine-boring the differential bearing bores and the driving pinion bores, and facing the outer end of the boss surrounding the larger pinion bore. Station No. 19 can be seen in the background in Fig. 12, and another view, from the opposite side, is given in Fig. 13. The side heads at this station, for finishing the bearing bores, have single spindles, each carrying two single-point tools, and driven at 240 r.p.m., to give a cutting speed of about 300 ft. per min., with a feed of 0·0024 in. per rev. Operations on the pinion bores and face are performed by tools in a spindle carried on an overhead slide, the supporting structure for which can be seen at the top in Fig. 12. Guideways on this structure support a travelling carriage, as seen in Fig. 13, which is moved from the retracted position shown, on the far side of the transfer track, to a central position, for the fine-boring operation, by means of a horizontal hydraulic cylinder.

It is necessary to retract the carriage in order that platens, carrying finished components, can pass from station No. 19 to be turned round and unloaded at station No. 20, which is out of sight to the right in Fig. 13. When the carriage has been moved to the central position above the transfer track, ready for fine-boring, it is located and locked in position by means of dowels and clamps operated by the two hydraulic cylinders *B*, and two similar cylinders on the opposite side of the overhead structure. Guideways on the carriage support the boring and facing spindle, which is driven by two sets of three V-belts, from a motor of 5 h.p., mounted at the far side of the carriage. The boring spindle of the head carries tools for finishing the large and small pinion bores to 5·187/5·188 and 2·834/2·835 in. diameter respectively.

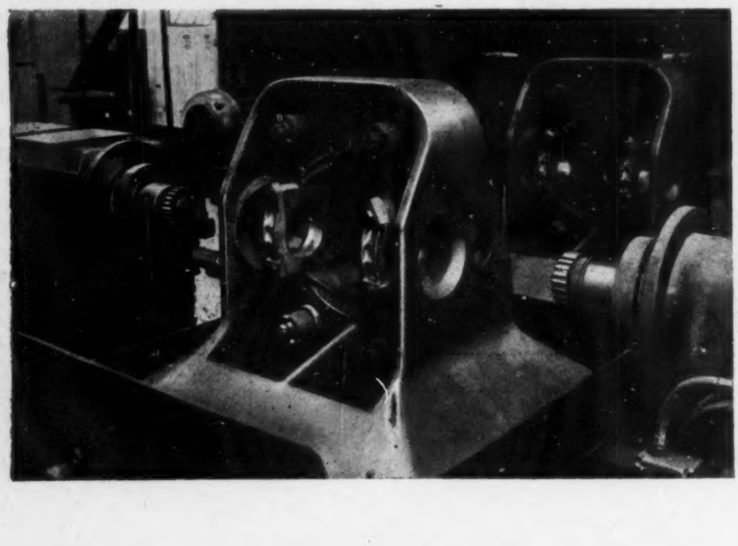


Fig. 12. After the differential bearing cap bores have been roughed and semi-finished, the outer ends are threaded by planetary type milling heads at each side of the machine at station No.18

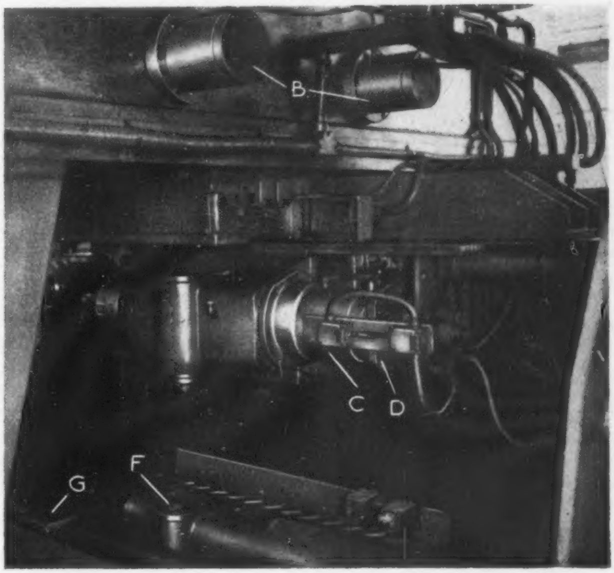


Fig. 13. The driving pinion hubs are fine-bored in line, the outer end is faced, and the larger bore is chamfered by tools in this spindle head, which moved into position after the platen has been double-indexed to provide clearance

The facing slide for machining the end of the boss surrounding the large bore, and chamfering the outer end of the bore, is actuated in a similar manner to that described in connection with station No. 4, by means of a hydraulic cylinder, mounted co-axially with the spindle. This cylinder is indicated at *C*, and, as in the previous example, the ram is extended towards the rear and carries a plate *D*, with adjustable stops which operate micro-switches at the limits of travel of the facing slide. These switches operate solenoid valves which control the machine movements in the correct sequence. For the boring operation, the spindle is driven at 265 r.p.m. and the head is advanced at 0·0039 in. per rev., and for facing, the speed is reduced to 195 r.p.m. At the end of the facing cut, the tool slide is retracted, and the head is returned to the position shown, before the carriage is moved back to the far side of the overhead support, ready for the next indexing motion of the machine.

When this indexing motion takes place, the platen, with the completely machined casting, is moved to a position alongside the carriage and directly beneath the overhead structure, one of the locating dowels at this position being seen at *F*. The transfer bar, which has an ear *G*, on the opposite side to those on previous portions, is then returned to the right, and the second of the two cylinders mentioned in connection with Fig. 10 is actuated to turn the bar in the opposite direction to that employed for the normal transfer movement. This action raises the ear *G*, and another ear to its right, the other ears being simultaneously lowered. The bar is then moved longitudinally to the right, pushing the platen clear of the carriage and the overhead structure to the unloading station (not shown in Fig. 5).

A view of this station is given in Fig. 14, looking in the direction of travel of the platen, and it is equipped with a mechanism, of similar design to that employed at station No. 14, which turns the platen so that it faces the same way as at the loading position. On the far side of the machine there is a head similar to that at the loading position, which can be brought forward by the operator responsible for unloading and inspect-

Fig. 14. In this view the platen at the left is at the unloading station, at which the clamps are released by a semi-automatic head. After the work has been removed, the platen is advanced into the elevating unit at the right

ing the castings, to loosen the clamping nuts. This operator then removes the casting from the platen and transfers it to the adjacent gauging station. At the next indexing motion of the machine, the unloaded platen is moved on to the platform of the elevating unit at the right in Fig. 14, on which it is raised to the level of the overhead return track.

The elevating and lowering units are of similar design, and each incorporates two substantial cylindrical columns, as seen at *H*, which provide guide-ways for rollers set in slots in the sides of the platform. For raising and lowering the platform, there are two double roller chains which pass over sprockets at the top and bottom, the lower sprockets being driven, through a reduction gear and a friction clutch, by a motor installed outside the cabinet housing. A slat-type conveyor extends for the entire length of the machine to remove swarf, which is pulled along a central square-section channel, and discharged, above floor level, into box pallets at the loading end of the machine. The complete cycle time for the operations described is 3·4 min., and the machine is normally tended by two operators and one setter.

INSPECTION FIXTURES

Castings which have been removed from the machine are de-burred manually, where necessary, and are stamped with identifying letters on the caps and pillars to assist in re-assembly at later stages. Inspection is then carried out, first with the aid of the equipment shown in Fig. 15, which checks the relative positions of the two main bore axes, and their squareness to each other, also the positions of certain faces. The casting is placed on a datum surface, on which it rests on the end boss surrounding the main pinion bore, and a two-diameter spigot is raised by means of an air cylinder controlled by the two series-connected valves in the foreground. Steel bushes are inserted in the differential bearing bores, and through them is passed a test bar with cylindrical surfaces at each end.

These surfaces make contact with the ends of plungers which project vertically upwards from brackets on the fixture base, and the movements of the plungers are transmitted to the anvils of dial gauges, through lever mechanisms. A post on each side of the position occupied by the casting carries a swinging arm with a dial indicator, and the anvils of these instruments can be brought into contact with the outside surface of the main spigot, adjacent to the flange, to check its position relative to the pinion bores. The gauge *J*, lying on the front of the fixture, incorporates a dial indicator, and the opposite end is inserted, to a fixed distance, in a central bore in the stepped spigot. A plunger on the side of the gauge, connected to the dial indicator, then comes into contact with the inner face adjacent to the small pinion bore, the height of which, relative to the lower machined surface of the casting, is thus checked.

At the right is seen a bracket *K*, with channels which can be engaged with the central portion of the test bar, and when this bracket is placed in position, a pin at each end should enter one of the two holes *D*, Fig. 1, employed for the location of the casting on the transfer machine. From this fixture, which is normally used for percentage checking only, the castings are transferred to the air-operated gauging unit shown in Fig. 16, for measurement

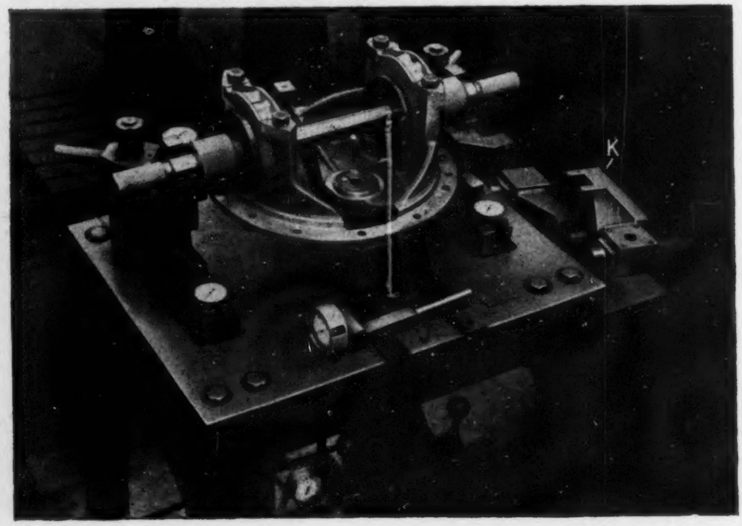
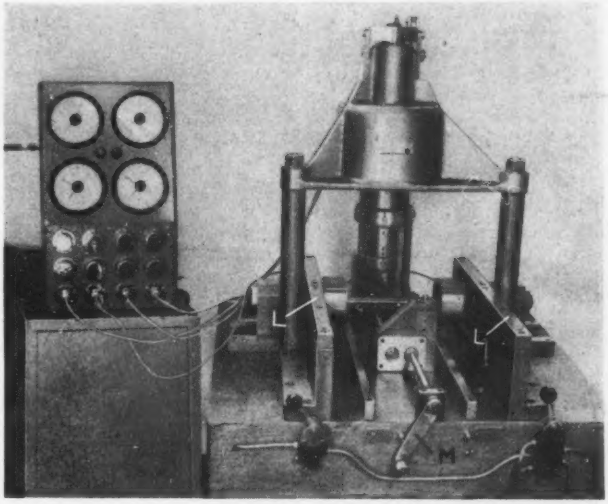


Fig. 15. Inspection of the relative positions of the differential bearing and driving pinion bores is carried out with this receiver gauge which incorporate dial gauges

Fig. 16. A fixture supplied by Thomas Mercer, Ltd., is employed for checking the bores for diameter and ovality. Mechanical contacts are provided to avoid errors due to variations in surface finish in the bores



of the diameters of the driving pinion and differential bearing bores. Supplied by Thomas Mercer, Ltd., this unit incorporates four indicator dials, which are grouped on a single panel at the left for ease of reading, and graduated in widely-spaced 0·0001 in. divisions. In addition, the panel is provided with red and green lamps, one of which is illuminated to indicate to the operator that all the bores are within, or that one or more of the bores is outside, the dimensional limits which are specified.

In the fixture, the casting is loaded, initially, with the machined side of the main flange resting on the two flat support surfaces *L*, and is then pushed to the rear where it is finally located by means of two dowels, which are raised by means of the lever *M*, to enter the holes *D*, Fig. 1. Above the position now occupied by the casting, there is a measuring head which provides for checking the diameters of the two pinion bearing bores. Two more heads, one on each side of the casting, serve to check the two differential bearing bores, and each head is mounted on the ram of an air cylinder, whereby it is advanced into, and retracted from, the bore. The measuring heads are so mounted that they can float slightly to accommodate small amounts of misalignment, and incorporate mechanical contacts so that variations of surface finish in the bores do not affect the accuracy of the readings.

The air cylinders, on which the heads are carried, are controlled by the two series-connected valves at the front of the fixture. These valves must be operated, so that the inspector's hands are clear of the moving parts before the cylinders are energized. After the heads have been engaged with the respective bores, they may be turned by hand if a check for ovality is required. The photograph for Fig. 16 was taken before the fixture was installed in the factory, and the side gauging heads have since been fitted with simple sheet metal guards having L-shaped slots, through which handles secured to the heads project. With this arrangement, the gauging heads can be turned through about 90 deg. only when they are engaged with the bores, and must be returned to their original position before they can be retracted.

From the gauging station, the castings are taken to a washing machine, and thence to the assembly line where the driving pinion and differential mechanism are fitted.

ALL-WEATHER FORK-LIFT TRUCK.—An all-weather fork-lift truck has been supplied by the Yale & Towne Manufacturing Co., Ltd., Wednesfield, Wolverhampton, to Metropolitan-Vickers Electrical Co., Ltd., for use both inside and outside their works. The truck, which is a series 51, rated at 8,000 lb. capacity and fitted with an adjustable jib attachment, has a totally-enclosed driving cab of sheet steel construction, complete weather protection being thus provided for the operator. There is a total of 25 sq. ft. of window space, glazed with Triplex safety glass, which ensures good all-round visibility.

The truck is employed for setting-up drop stamps in the forging section, where difficulty would be experienced in introducing a jib crane between the arms of a drop hammer, also in the maintenance department, where its manœuvrability facilitates the movement of bulky parts through low doorways.

Outside the factory, the truck is employed, for example, for transporting large cylindrical oil conservator shells, weighing 30 cwt.

H

Typical Operations on Components for the Convair 880 Jet-propelled Air-liner

The Convair Division of the General Dynamics Corporation, San Diego, Calif., U.S.A., has spent 22 million dollars on tooling and other facilities in preparation for building the Convair 880 jet-propelled air-liner. Of this total, machine tools and associated equipment accounted for nearly 4 million dollars, and further expenditure under this heading is anticipated.

The Convair 880 is designed to serve cities of medium size, and is suitable for existing runways. It is stated that it can be operated profitably at ranges of 300 to 3,000 miles. Eight-eight passengers are accommodated in the de luxe-interior plane and 109 passengers in the tourist version. The aircraft is intended for altitudes up to 40,000 ft. and will have a maximum take-off weight of 178,500 lb. It is understood that the Convair 880 will be in service on important airlines by the spring of 1960.

Over 1,000,000 sq. ft. of factory space has been provided for production of the 880, and most of the new manufacturing equipment has been installed. Machine tools specially designed for economical operations on the 26,000 different structural parts (exclusive of systems) required for each aircraft are a feature of the production lines. As far as possible, the new machine tools are automatically operated by means of tape and electronic controls.

One of the most spectacular machines is a duplex-carriage, 105-ft. long Onsrud spar mill of which a close-up view is shown in Fig. 1. It incorporates electro-hydraulic controls to enable good finish and accuracy to be obtained at high speeds. In this illustration, the machine is seen operating on the lower-keel longeron for the 880 aircraft, which weighs 1,700 lb. in the extruded form and only 310 lb. when finished. Modifications to the extrusion, for subsequent batches, will result in a reduction of weight, before milling, to 1,200 lb.

The keel is of constantly varying cross-section so that it is necessary to impart up-and-down and angular movements to the cutter-heads as each of the two carriages moves along the bed. One carriage is equipped with a horizontal and a vertical milling head, and the second has four horizontal heads. In Fig. 1, a milling head on the first carriage is seen in an approximately horizontal position, whereas in Fig. 2, it is tilted to a

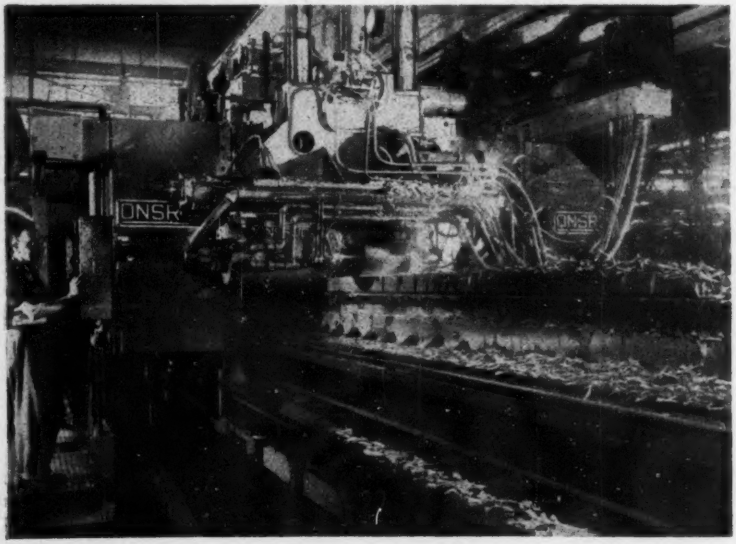


Fig. 1. On this Onsrud spar mill, components up to 60 ft. long by 3 ft. wide can be machined. There are two carriages, one with a vertical and a horizontal head, and the other with four horizontal heads

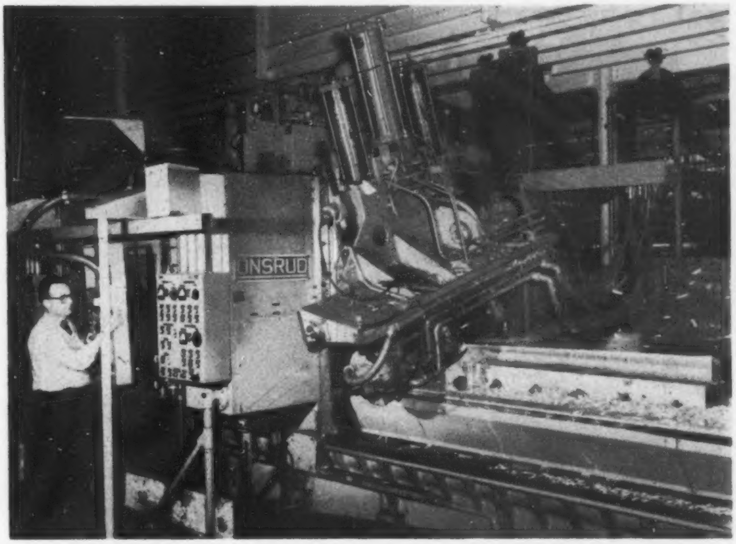


Fig. 2. The horizontal heads on the spar milling machine can be tilted through angles up to 45 deg. in either direction

considerable angle. Milling cutters up to 16 in. diameter and up to 18 in. wide can be employed.

Selsyn tracer controls supplied by the General Electric Co. impart the required movements to the milling cutters as either carriage travels along the bed. The cam followers on the tracer units engage cams mounted along the front of the bed as seen in Fig. 3, and the required movements are thus imparted to the milling heads through an electro-hydraulic control system, the power for these movements being provided by torque motors. Speeds of 1,800 and 3,600 r.p.m. are available for the horizontal heads, and of 3,600 and 7,200 r.p.m. for the vertical head. The heads are driven by 100-h.p. motors. Parts up to 60 ft. long by 36 in. wide can be handled on this machine which is equipped with a chip conveyor.

SKIN MILLER WITH MAGNETIC TAPE CONTROL

The greatest importance is attached by Convair production engineers to the numerical control of machine tools for use in the aircraft industry. Their experience led to the installation of the large Giddings & Lewis skin miller shown in Fig. 4, which is completely controlled by a magnetic tape. The vertical and horizontal heads are operated in these planes, and at prescribed angles, by a Numericord control system.

This system is capable of operating the machine with two heads, and with continuous motion on five axes, in addition to performing 12 switching and auxiliary functions. The control cabinet, seen at the extreme right in Fig. 4, is provided with visible h.p. consumption meters, rate-of-feed indicators, and manual controls for setting-up purposes or for operating the machine when a tape is not being used.

Fig. 3. Vertical movements of all cutter-heads on the Onsrud machine, also lateral and tilting movements, are controlled by long cam-plates mounted at the front of the machine bed

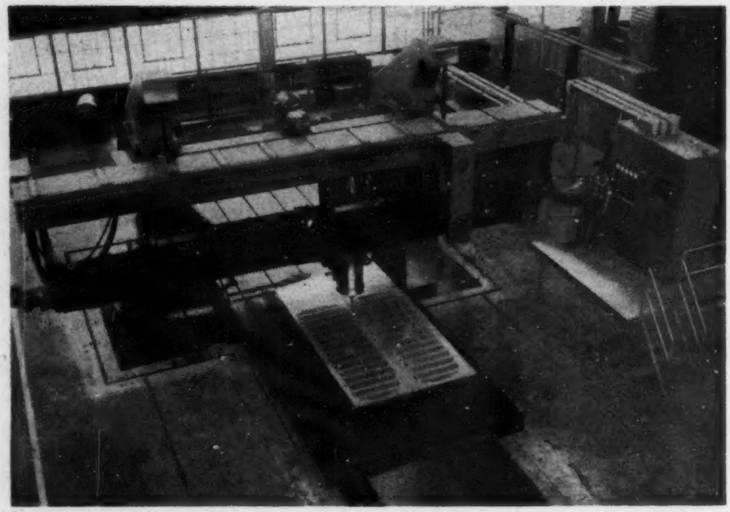


Fig. 4. Large Giddings & Lewis skin miller which is completely controlled, from magnetic tapes, by the Numericord cabinet at the right

at the front of the table. There is also a hydraulic valve on the column of the machine for quickly changing the height of the cutter with respect to the work for taking cuts at different levels, and it is therefore unnecessary to provide a stepped template. A small turret with a series of micrometer stops graduated to 0·001 in. facilitates setting the cutter to different heights.

A typical application of the horizontal head is shown in Fig. 5, where integral ribs are being milled. The bed of the machine will accommodate work up to 30 ft. long by 10 ft. wide, which is sufficient for the panels of the swept-back wings of the 880 aircraft. The milling head motors deliver 50 h.p. at 1,800 r.p.m. and 100 h.p. at 3,600 r.p.m. Mist lubrication is supplied to the milling cutters during the operation.

VARIAX PROFILING MACHINE WITH NUMERICORD CONTROL SYSTEM

The Giddings & Lewis Variax profiling machine shown in the close-up view in Fig. 6 is also numerically controlled. Any part up to 168 in. long by 48 in. wide can be milled automatically along three axes without the necessity for using templates to guide the cutter. A Numericord unit provides 14 channels of instruction. It is capable of operating the cutter-head in the three axes of motion, and, in addition, performs 12 switching and auxiliary functions. Once the milling head has been lined up manually, the operator is only required to press a button to start the machine cycle. Operations that formerly required 10 hours are now performed in 70 min. with this numerically-controlled equipment.

An exceptionally versatile profiler, the Sundstrand profile milling machine, which is widely employed at the Convair works for both heavy and light operations, is shown in Fig. 7. Cuts are controlled in two dimensions by moving the stylus of a True-Trace hydraulic head along a template

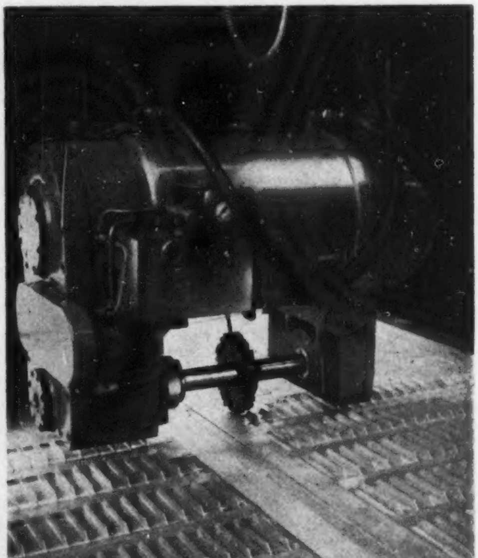


Fig. 5. A typical operation is here being performed with the horizontal head of the skin miller, on a panel with a series of integral ribs machined from the solid

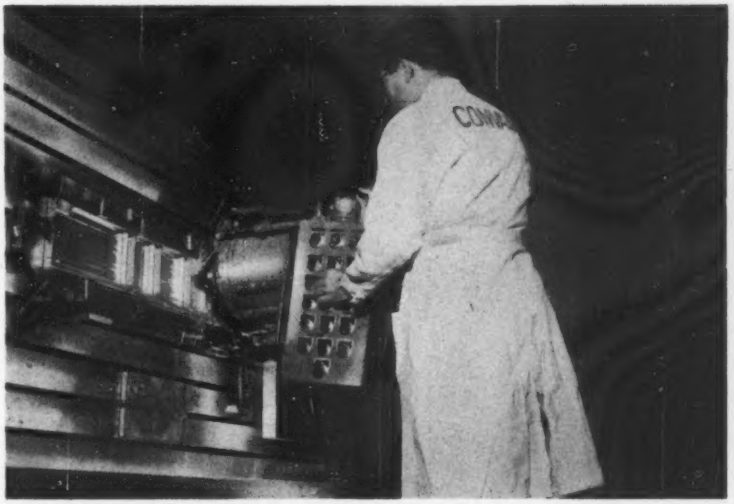


Fig. 6. A typical operation in progress on a magnetic tape-controlled Variax profiling machine

Cuts as deep as 2 in. have been taken on this machine with a cutter of 1¼ in. diameter at high speed and feed rates. Speeds from 52 to 1,990 r.p.m. are available, and the feed is governed by manual manipulation of the tracer stylus. Standard end- and face-milling cutters are employed.

Routing has been substituted for profile milling on certain light-section structural members, one of which is seen on an Ekstrom-Carlson machine in Fig. 8. In this instance, the router is used for cutting elongated holes in one leg of a wing-bulkhead rail part, and for profiling along the edge of this leg. Notches of different depths are also routed in the leg that is seen upright in the illustration. These notches are, of course, cut with that leg of the structural member mounted horizontally on the table of the machine. Templates clamped to the work guide the cutter.

The machine is equipped with a water-cooled motor that provides speeds of 7,200 and 14,400 r.p.m. Depth stops on the side of the head limit the down movements. Special fixtures are provided for the various components, and clamps attached to the front of the table apply pressure to the work both laterally and vertically. Other typical work handled by this machine includes light spars and stiffeners.

The Arrow profiling machine in Fig. 9 is equipped with a cutter-head that can be swivelled through 20 deg. in either direction from the vertical centre line, to enable " twists " to be machined. Straight movements of the cutter-

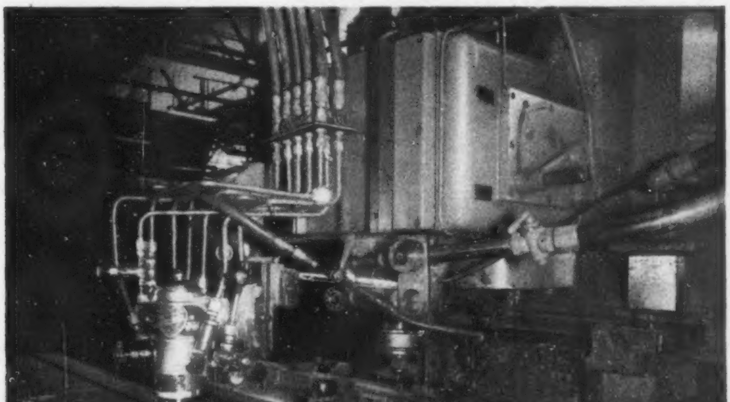


Fig. 7. A close-up view of a typical operation in progress on a Sundstrand profiling machine which is controlled by a True-Trace hydraulic head from a template at the front of the table

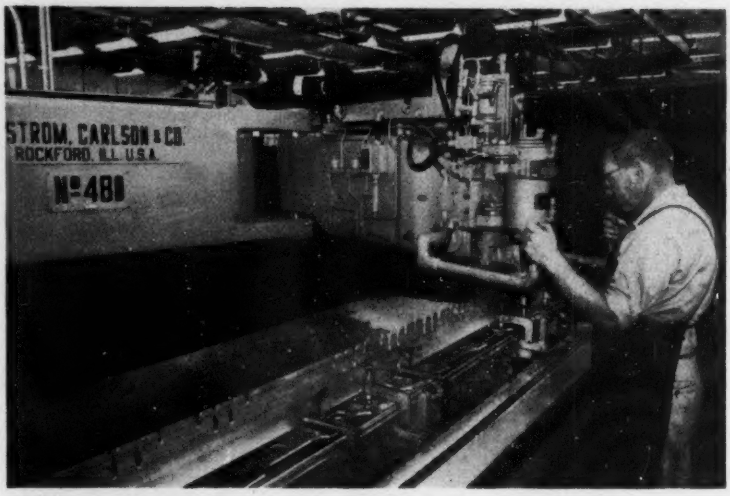


Fig. 8. An Ekstrom-Carlson routing machine is here being employed for producing elongated holes, contoured edges, and notches in a structural member for Convair 880 aircraft

head up and down and transversely are controlled by the True-Trace hydraulic head which the operator is guiding along a template in Fig. 8. Pivoting movements of the cu'ter-head are obtained by means of a second tracing valve unit with a roller, which is seen adjacent to the cutter-head. Spindle speeds from 37 to 3,000 r.p.m. are available.

The large fuselage belt frames required for the 880 transport aircraft necessitated the installation of the 75-ton Cyril Bath radial draw-former shown in Fig. 10, which is believed to be the largest of its type in the world. Various other parts made from extrusions are handled on the same machine. The illustration shows an aluminium H section, which measures 3$\frac{1}{16}$ by 4$\frac{3}{8}$ in. and has cross sectional thicknesses up to $\frac{3}{8}$ in., being stretch-formed to an outside radius of approximately 6 ft.

One of the features of this machine is a yield and tension control. Signals imparted by a load cell on one pulling head are transmitted to an amplifier which gives readings for yield, tension, and elongation. After one piece has been formed to specification, duplication of settings on the instrument panel will ensure the production of subsequent pieces with the same characteristics.

This radial draw-former is also used for ironing T-sections to the required contours, and such an operation is shown in Fig. 11. The work is mounted on a form block of the re-

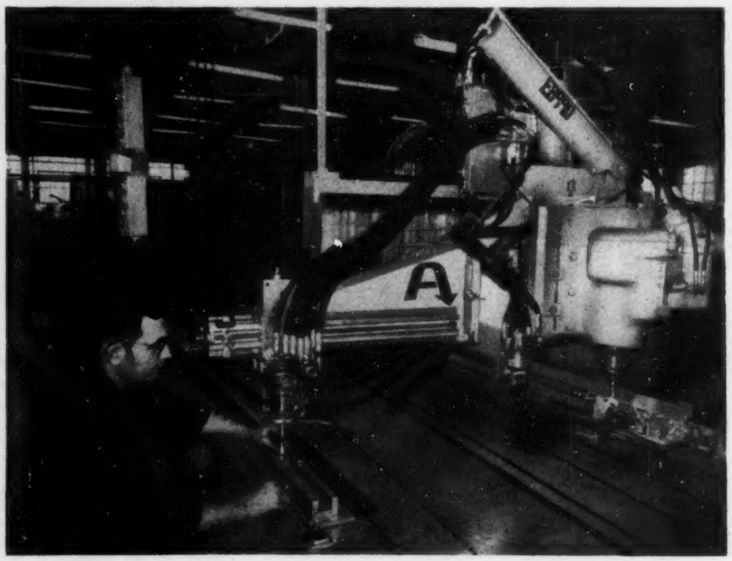


Fig. 9. An Arrow profiling machine on which the cutter head can be swivelled for taking angular cuts, in addition to being moved vertically and horizontally

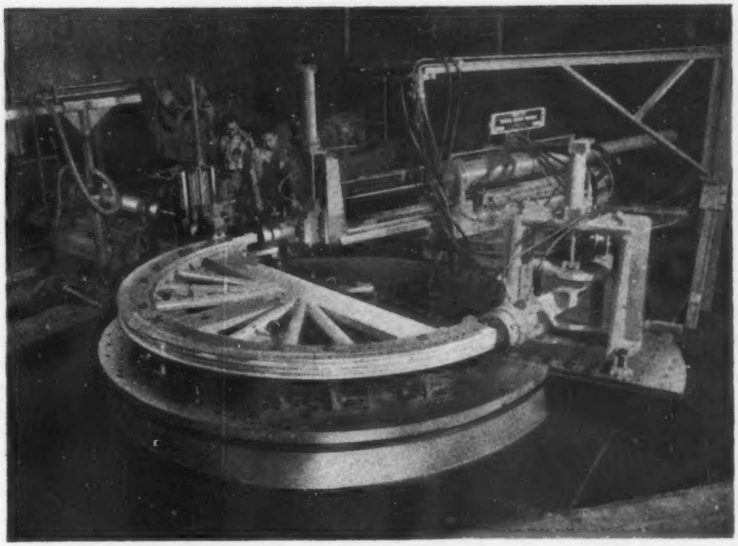


Fig. 10. Cyril Bath radial draw-former of 75 tons capacity which is used for producing large fuselage belt frames and a variety of other parts

quired contour, and the traverse slide is moved over the work lengthwise, this slide being fitted with a suitable die for pressing the part against the form block. For all applications, the machine is hydraulically operated under electrical control.

Before parts are sent to the radial draw-former, they are thoroughly cleaned with Oakite in tanks, and heat-treated in the Despatch oven shown in Fig. 12. The oven has a work space 41 ft. long by 8 ft. wide by 8 ft. high, and is believed to be the largest of its type in use in the U.S. aircraft industry.

It is electrically heated and can be maintained at temperatures ranging from 400 to 1,300 deg. F. In conditioning the aluminium-alloy structures for the 880 transport aircraft, temperatures ranging from 860 to 920 deg. F. are normally employed. From 30 to 60 min, is required to bring parts up to the desired temperature. They are then soaked for 1 hour.

For heat-treatment, the work is loaded on the structural-steel rack seen in Fig. 12. Then, the rack is pushed into the space beneath the oven and lifted by a hydraulic elevator into the oven tower. At the end of the heat-treating period, the rack, with its load of work, is quickly lowered into a quenching tank in a pit directly below the furnace. From the time that the oven doors are opened until the work is completely immersed, not more than 10 sec. must elapse. In practice, the operation has been carried out in 6½ sec. The water in the quenching tank is held at a tempera-

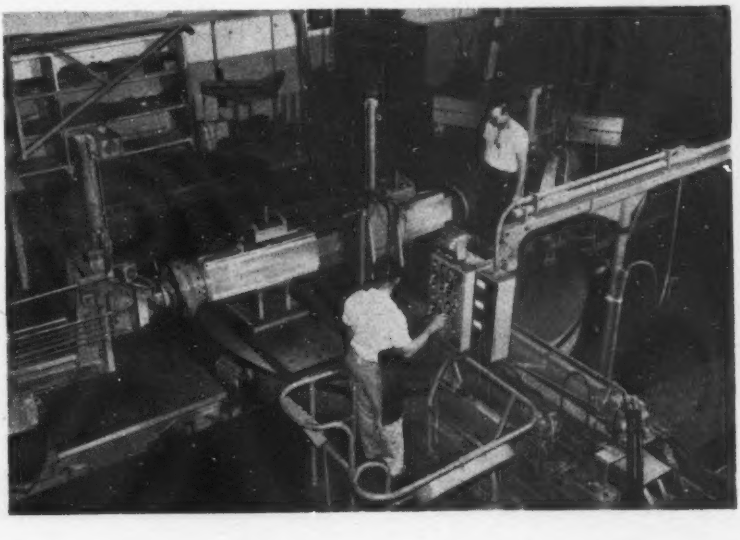


Fig. 11. An aluminium-alloy T-shaped extrusion is here ironed to the required contour on the large radial draw-former

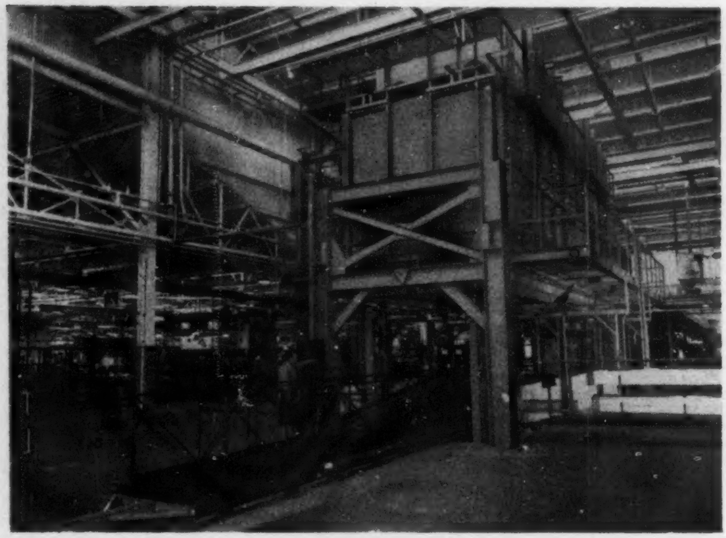


Fig. 12. This oven, used for the heat-treatment of aluminium-alloy structural members prior to radial draw-forming or ironing, is claimed to be the largest in the U.S. aircraft industry

ture of 65 deg. F., and parts remain in the tank for approximately 1 min.

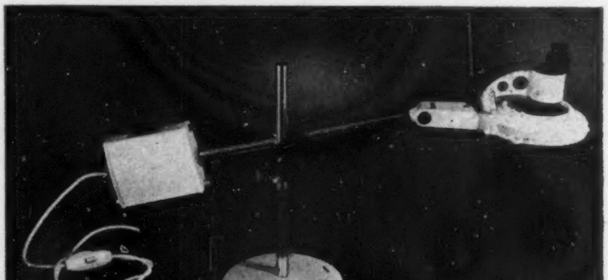
It is essential to prevent aluminium sections and sheets ageing between the heat-treating and drawing stages. For this reason, a refrigerator, more than 40 ft. long, has been installed. The workpieces are stored in this refrigerator as soon as they have been quenched. The refrigerator is maintained at a temperature of −20 deg. F., and racks are provided along the walls, on which the sections are supported.

Frigolux Cold-light Illuminated Magnifier

Optical-Mechanical (Instruments), Ltd., 17, Station Road, Egham, Surrey, have been appointed sole selling agents in this country for the Frigolux illuminated magnifying unit shown in the accompanying illustration.

Illumination of specimens is provided by a circular " cold-light " tube incorporated in the swivelling lens head, which is carried at the right-hand end of the adjustably-mounted cross arm. The 3·5-in. diameter lens provides a magnification of 2 ×, but a supplementary prism monocular can also be accommodated, which, in conjunction with the standard unit, gives magnifications of 9 and 14 ×, at the same working distance. Power is supplied to the light source through a transformer at the opposite end of the cross arm which serves as a counterweight to the lens head. In place of the circular base shown, the magnifier can be supplied with a clamp at the foot of the vertical post, and it can then be secured to a bench.

It is claimed that with the light source employed, illumination is dazzle free and is so evenly distributed that shadows are largely eliminated. No heat is radiated from the tube, and the daylight type of illumination provided, ensures viewing conditions which enable colours to be accurately distinguished.



Frigolux cold-light illuminated magnifier which incorporates an annular lamp

Lost Wax Investment Casting

Some Recent Developments by Trucast, Ltd.

The process of lost wax investment casting employed by Trucast, Ltd., is being operated under licence by a number of important firms in this country, including Rolls Royce, Ltd., The Fairey Aviation Co., Ltd., and Deloro Stellite, Ltd., also in France, Sweden, Spain, Switzerland, and Canada, and at the company's works at Farnham Royal Lodge, Bucks., certain developments and improvements to the process have been introduced in recent years. Attention has always been paid to increasing the overall size of refractory mould which is used, to allow a greater weight of metal to be poured at one time and thus increase the ratio of "useful" metal to that required for runner bars, for example. Such increases have been achieved by employing what is known as a "dual-gravity" refractory material, which, by providing increased strength, allows a larger mould to be handled.

In addition, in order to reduce the time required to produce the wax patterns, the company has developed a standard wax injection press which, when using a single-impression die, will produce the patterns at the average rate of 4 per min. A method of injection has been adopted whereby the natural high coefficient of contraction of the wax is, to a large degree, counteracted. Also, by the use of a new form of pre-coating material, the surface defects known as "slag spots," or "fusion," which frequently occur when casting chromium alloys of the martensitic type, also, to a lesser degree, with 18/8 stainless-steel, have been eliminated. Investigations have shown that these blemishes are caused by the fusion of the silica pre-coating, which is applied to the wax tree before investment, and the molten metal, and that they increase in number in proportion to the amount of time the metal, in its molten state, is in contact with the mould.

In some cases, these defects can be avoided, or reduced, by arranging for the mould to be cooled quickly, with the result that the metal solidifies rapidly. When thin sections are being cast, however, it is not always possible to follow this procedure, and the special pre-coating, which consists of a basic refractory material, is then employed. It is claimed that the use of this pre-coating eliminates "slag spots," and that the steels mentioned above can readily be cast without blemishes.

Great care must be taken during the pre-coating of the wax trees, also during the subsequent drying process, and a bank of air-tight drying cabinets has been built in which the temperature and humidity can be accurately controlled. These cabinets are installed so that they form a dividing wall between the pre-coating and investment departments, and a door is provided at each side of each cabinet, to enable the patterns to be loaded from one side and withdrawn from the other.

WAX INJECTION MACHINE

The latest type of wax injection machine, to which reference was made above, is shown in Fig. 1. This machine is used in conjunction with an electrically-heated holding tank with a capacity for 2½ cwt. of wax. A feature of this machine

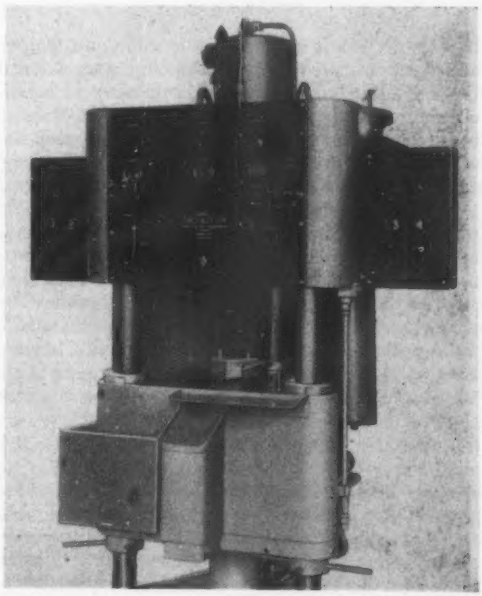


Fig. 1. The wax pattern injection machine which has been developed by Trucast, Ltd., for producing wax patterns from a single-impression die at the average rate of four per min.

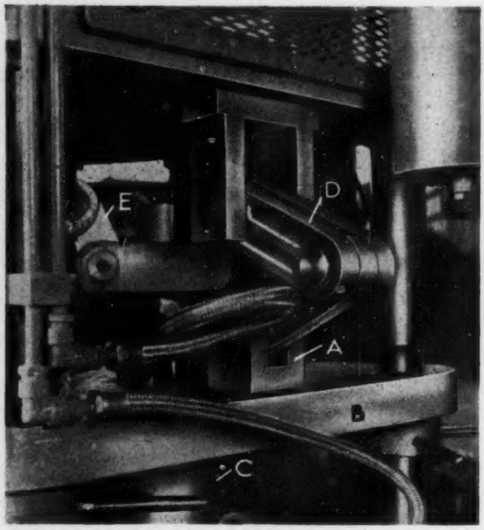


Fig. 2. The air-operated toggle mechanism for raising the lower die platen of the wax injection machine shown in Fig. 1

is that the wax is injected at the minimum temperature necessary to ensure plasticity, and, once in the mould, it solidifies quickly to a condition in which it may be handled without risk of damage or deformation. Moreover, by injecting the wax at the lowest possible temperature, shrinkage during cooling is reduced to the minimum. Accordingly, considerable attention has been paid to the means for maintaining the wax at the required temperature. The upper part of the machine houses the main injection cylinder, also four auxiliary holding cylinders, and is filled with water which is kept at a temperature of approximately 80 deg. C. by means of electric immersion heaters. Each holding cylinder is connected by a pipe to the injection cylinder, and contains a piston and rod coupled to a double-acting air cylinder. Wax is transferred from the main holding tank to the four auxiliary cylinders, which are open at the top and are fitted with removable covers. Individual controls are provided for each of the four double-acting air cylinders, and with this arrangement the wax in the holding cylinders can be transferred to the injection cylinder as required.

Handles seen projecting from the panels at the right and left of the machine in Fig. 1 serve for controlling the discharge of wax from the holding cylinders, and an interlocking mechanism is incorporated to ensure that wax is passed to the injection cylinder only when the latter is idle. On the centre panel, there are controls for raising and lowering the bottom platen, and injecting the wax. Dial-type instruments are provided to indicate the temperature of the wax, also the pressure of injection, and a red pilot light is incorporated which gives a warning when the injection cylinder requires replenishing.

The bottom platen of the machine, to which the lower die is clamped, is raised and lowered by means of a double-acting vertically-mounted air cylinder, which works in conjunction with three toggles. These toggles are equally-spaced around the air cylinder, and one is seen in the close-up view, Fig. 2. The lower arm is pivoted to the block *A*, which, in turn is attached to the fixed triangular plate *B*. This plate is located by the three ground vertical tie-bars of the machine, and serves also to support the air cylinder, which is just visible at *C*.

Each upper toggle arm, *D*, is pivoted to a block attached to the underside of the moving platen, and is extended past this pivot point to be connected by a plain link (as at *E*) to a bracket on the piston rod. As the latter rises, to elevate the lower platen, the toggles are brought to the dead centre positions to lock the dies in position, mechanically, irrespective of any variations in the air line pressure.

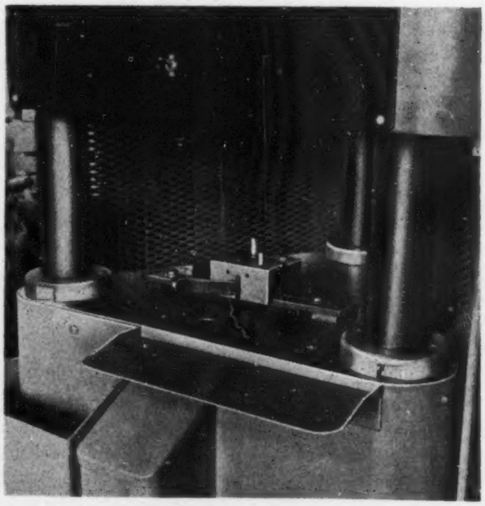


Fig. 3. Close-up view of the lower die platen of the Trucast wax injection machine, with the bottom half of a die clamped in position. The lever seen projecting from the front of the die operates an ejector for removing the wax pattern

The capstan-type adjusting nuts, seen below the bottom plate *B* in Fig. 2, provide for the initial setting of the bottom platen assembly, as a complete unit, to accommodate different die thicknesses. A close-up view of the working surface of the bottom platen, with the lower half of a die clamped in position, is shown in Fig. 3. The lever seen projecting towards the front operates an ejector for removing those patterns which remain in the bottom die after injection, and there is an automatic ejector, mounted coaxially with the injection nozzle in the upper platen, for patterns which remain in the upper die member.

In addition to maintaining the temperature of the wax as low as is consistent with plasticity, the machine injects the wax under a pressure of 1,000 lb. per sq. in. to ensure that the cavity is completely filled, and to assist in counteracting the high coefficient of contraction.

Depending on the size of the die cavity, which determines the volume of wax required, this machine will produce between 2 and 6 patterns per min., from a single-impression die. When the dies are opened, after the injection period, the pattern can be removed at once, and handled without risk of damage or deformation. This wax injection machine, which is known as the series 200, Mark 7, has been developed by the company for its own use, and that of its licensees, and the machine shown in Fig. 1 was photographed immediately before despatch to the Swedish firm of Nyby Bruk AG.

RADIO-FREQUENCY FURNACE

Also designed and built by the company for use by licencees is the furnace shown in Fig. 4. Radio-frequency heating is employed exclusively in the Trucast process in order to avoid the possibility of carbon pick-up. Consequently, the range of materials which can be used for investment casting is widened, and it is interesting to note, for example, that Swedish iron can be cast with total impurities of less than 0·1 per cent, and with a carbon content below 0·04 per cent. Another material for which r.f. heating is essential is a type of heat-treatable stainless steel known as Trubrite. This alloy, which has a maximum carbon content of 0·04 per cent, and contains Cr. 26; Ni. 5; Mo. 2; and Cu. 3 per cent, has a normal tensile strength of 60 tons per sq. in., and possesses corrosion-resisting properties superior to those of 18/8 stainless-steel.

As may be seen in Fig. 4, the crucible is trunnion-mounted, and the refractory mould is clamped in the inverted position to the top face. For pouring, the mould and crucible are rotated through

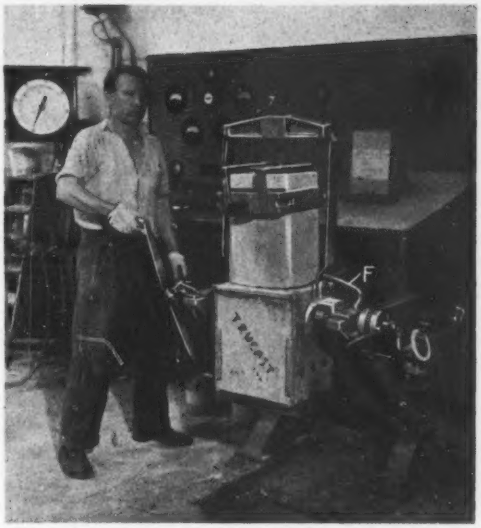


Fig. 4. The Trucast furnace, with a mould clamped in position ready for pouring. Radio-frequency heating is employed, to avoid the possibility of carbon pick-up

180 deg., as a complete unit and the molten metal is transferred, by gravity. At *F* in Fig. 4 is shown the inlet connection for a supply of air which is introduced to take the place of the metal, as it leaves the crucible, and impose a nominal pressure to ensure that the cavity is completely filled.

An electric motor and 2-speed reduction gear are used for inverting the crucible and mould, but this operation can also be carried out manually, as it is desirable, in some instances, to vary the speed of rotation slightly during the early stages of inversion. When pouring has been completed, the mould is unclamped from the furnace and removed to the cooling area.

STRONGER REFRACTORY MATERIALS

As was mentioned earlier, the weight of metal which can be poured at one time, and consequently the number of castings which can be produced as one tree, is determined to a great extent by the strength of the mould. The latter must possess sufficient strength to withstand the entry of the molten metal, also the handling necessary prior to the pouring, and the special refractory which has been developed enables moulds to be made with maximum dimensions of 11 by 8 by 17 in.,

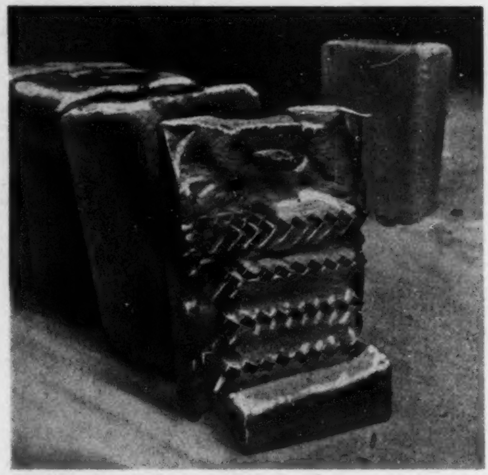


Fig. 5. This partially-opened mould shows the even texture of the "dual-gravity" refractory material, which, by providing increased strength, has enabled mould sizes to be increased

capable of receiving 30 lb. of molten metal. This "dual-gravity" mould material consists of a mixture of coarse and fine grains. The coarse grains have a low, and the fine grains a high, specific gravity, and the two materials are mixed in such a proportion that during the vibrating process which follows the initial investment, no segregation occurs. As a result, the coarse and fine grains are distributed evenly throughout the mould, and, after firing, a strong refractory is obtained. Magnesia or sillimanite is used for the coarse, and zircon for the fine grains. The even texture of the moulding material can be seen in Fig. 5, which shows a partially-opened refractory and one side of a tree of 72 turbine blades.

An indication of the manner in which the patterns are assembled to form a tree is afforded by the group of waxes for Rolls-Royce turbine blades shown in Fig. 6.

Each blade measures 7¼ in. overall, and by careful arrangement a total of 10 has been attached to the two horizontal runners. It may be noted that the aerofoil section of these blades is hollow, and the resultant envelope of metal varies in thickness between 0·050 and 0·080 in., these dimensions being held, on average, within ±0·005 in. The tree of blades in Fig. 6 affords an example of the favourable proportion of "useful" metal to that required for runners, for example, obtainable by the use of the larger mould. Similarly, attention is drawn to the tree of 24 waxes shown in Fig. 7. These patterns, for a gyroscope component, measure approximately 2 in. diameter by 2 in. long. The wall thickness of the drum portion is 0·025 in., and whilst the limits called for are ±0·005 in. it is stated that, in practice, this dimension is held within ±0·003 in.

EXAMPLES OF INVESTMENT CASTINGS

One of the principal attractions of investment casting, from the economic point of view, is the possibility which it may afford for producing an integral assembly, as an alternative to the use of two or more separate machined components. Even where a casting replaces a single machined piece, however, a considerable number of operations can often be eliminated, and an example of such a conversion is shown in Fig. 8. At the left are seen the parts of a pawl assembly, of which right- and left-hand forms are required, in the fully-machined condition, when it comprised three separate pieces, namely the pawl *F*, the block *H*,

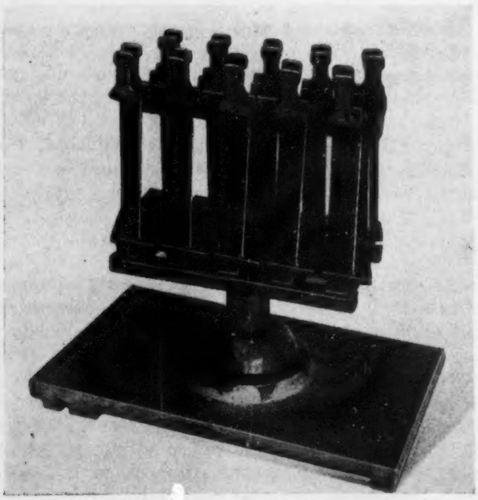


Fig. 6. A typical tree of wax patterns for turbine blades. These blades are approximately 7¼ in. long, and, by careful arrangement, a total of ten has been assembled in one tree. The aerofoil sections of these blades are hollow

Fig. 7. Wax patterns for a gyroscope component assembled as a tree. There are 24 of these waxes, each measuring approximately 2 in. diameter by 2 in. long, and the wall thickness of the drum portion is maintained to 0·025 in. ± 0·003 in.

and the spring anchor pin *G*. The part *F* was made from 1- by 2½- by 1⅝-in. section, bright drawn mild steel bar, which was annealed before machining. A total of 7 separate machining operations was required to produced this part, including horizontal milling (two separate machines), drilling (main bore and oil hole), oil grooving, profiling, surface grinding, and internal grinding. Two separate fitting operations were also involved, as well as cyanide hardening and straightening. In addition, the rectangular block and spring anchor pin were made as two separate items, and assembled to form a unit.

When the pawl is made by investment casting, as seen at the right of the figure, only two separate pieces are required. The material used is a cobalt-based alloy developed by the company, and known as Truhard 10, and no heat-treatment is necessary. Only four machining operations are carried out, namely, lapping the cast bore to 0·489/0·490 in. diameter, to receive an expanding mandrel for location purposes; grinding the end faces to the specified dimension and removing the riser (both operations being performed on the same horizontal grinding machine); internally-grinding the bore to finished size; and grinding the tongue, remote from the hooked end, to finished width. Hand work is confined to stoning the radius on the tip of the hook to obtain a neater appearance.

It will be noted that with the original, machined, design, lengthwise adjustment of the spring anchor pin was obtained by sliding the rectangular block in a machined groove in the pawl member. For the casting, the design was changed and the pin was made with a forked end which straddles the tongue cast on the boss. There is a cast slot in this tongue to provide the necessary adjustment, and no machining is required either for this slot or the anchor pin. It may also be noted that with the investment castings no tapped holes are needed, and the oil hole is cored and requires no machining.

Another advantage which was gained by making this assembly from investment castings was that the heavy section between the hook and the boss

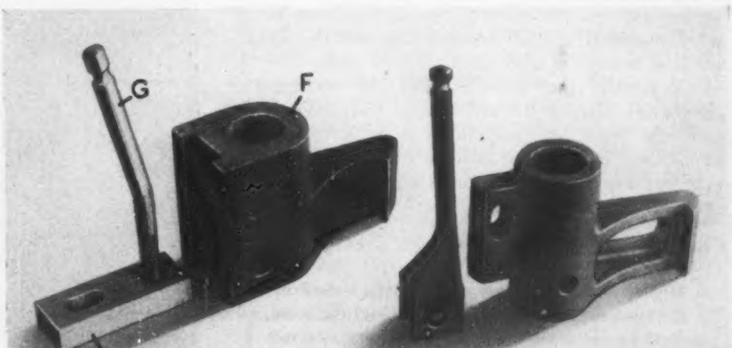


Fig. 8. The three fully-machined steel parts of the pawl assembly at the left have been replaced by the two investment castings seen at the right. A considerable reduction in machining time has been achieved, coupled with the elimination of a heat-treatment operation

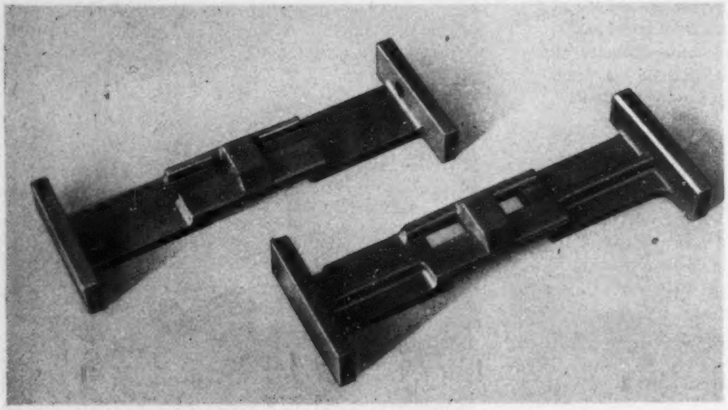


Fig. 10. The steel part at the left was machined from the solid. By employing an investment casting, as seen at the right, considerable economies in machining time have been achieved. It has also been possible to increase the strength of the part by providing a longitudinal rib

could be cored out, leaving an 1/8-in. thick rib at each side. It was found that by lightening the part in this manner, the balance, when in operation, was greatly improved. This pawl works continuously in conjunction with a cast iron ratchet wheel, and with the previous material the life of the hook was unsatisfactory owing to the wear which occurred. By using a cobalt-base alloy, the working life has been increased considerably.

The investment casting at the right in Fig. 9 has taken the place of the two machined items, at the left, which formed parts of a delivery chute and were assembled by soldering. Made from drawn brass of 3/16 by 5/8 by 1 1/2 in., the flange plate was milled to width on a horizontal machine. The semi-circular cut-out was produced on the same machine, and the part was then transferred to a vertical key-seater on which the two round-end slots were cut.

For the chute, half-hard brass sheet, measuring 1/32 by 1 7/16 by 2 1/2 in., was employed. All burrs were removed and all corners radiused, by hand, and the two parts were then cleaned and soldered. Subsequently, the assembly was despatched for chromium plating by an outside contractor.

Made from an austenitic stainless-steel, the investment casting requires no plating, and has a considerably longer life than was obtained with the previous design, which was determined entirely by the wear-resisting properties of the chromium plating. Immediately the latter exhibited signs of wear, the part had to be replaced. As an investment casting, the assembly requires only two machining operations, namely grinding the outside face of the flange square with the chute and removing the flash, both operations being carried out on a surface grinding machine. It will be noted that when this assembly was redesigned for investment casting, the opportunity was taken to provide a strengthening rib between the underside of the chute and the backplate, a feature which would have been difficult and expensive to incorporate in the previous assembly. The round boss in the centre of the rib is a casting runner, which was provided to ensure soundness of metal on the longitudinal centre line of the chute. This runner is trimmed back flush with the edge of the rib prior to the grinding operations. Finally, the

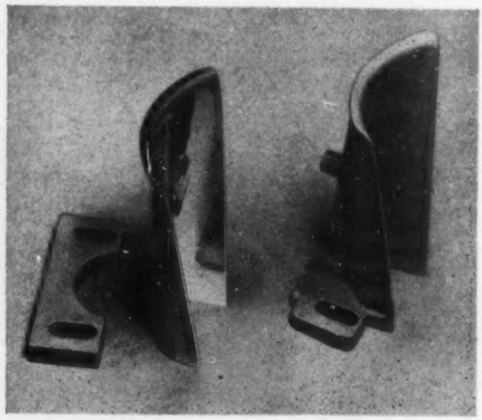


Fig. 9. A delivery chute was formerly made from the chromium-plated brass pressing and the brass plate seen at the left, the two pieces being soldered together. The assembly is now made as an investment casting from austenitic stainless-steel, as seen at the right

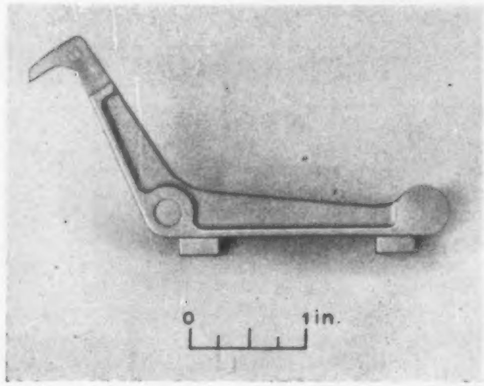


Fig. 11. With the exception of a change in cross-section to reduce the weight, this investment casting is identical in design to that produced hitherto by machining from solid $\frac{3}{16}$-in. thick gauge plate

part is straightened, if required, and the burrs are removed by hand.

Reductions in machining time were obtained by producing the workpiece at the left in Fig. 10 as a casting, the latter being shown at the right. Hitherto, this part was machined from the solid, in steel, and required a large number of different set-ups. The overall dimensions are 5¼ in. long by 1⅛ in. wide by ⅝ in. deep, and the centre section between the two $\frac{3}{16}$-in. thick end plates was machined away to leave an ⅛-in. thick connecting plate. An end-milling operation was required to produce the two $\frac{5}{16}$-in. wide by ⅛-in. deep slots on either side of the central raised portion, and semi-circular clearances were necessary adjacent to the latter to allow the cutter to run out.

The advantages which were gained by producing the part as a casting are obvious, and a strengthening rib was again included, in this case to improve the rigidity of the ⅛-in. thick connecting plate. All hand operations connected with the removal of sharp corners and burrs have been eliminated, and the only machining required is the facing of the end plates and the line boring of the three holes. It may be noted that the part identification number is also cast.

The pawl finger shown in Fig. 11 is another good example of a conversion from fully-machined steel to investment casting. Hitherto, this part was machined from the solid, from $\frac{3}{16}$- by 2- by 4-in. gauge plate, and involved lengthy horizontal milling operations. After milling, the burrs were removed by hand, the ¼-in. diameter hole was drilled and reamed, and the profile was filed to shape with the aid of a template.

A cyanide hardening operation followed, after which the part was straightened and cleaned and the hole was finish lapped. Finally, the overall width was brought to the required size by a surface grinding operation. As an investment casting, the cross-section was changed to a T-shape, and the part is cast from Truhard 10 cobalt-based alloy. After an initial straightening operation, the width is finished ground as hitherto, and the excess metal on the bottom edge is removed on the same machine. Next, the top edge of the hook is stoned, also the disc-like portion at the tail of the component. Finally, the ¼-in. diameter hole is internally ground. No heat-treatment is required.

When in use, this part performs 900 oscillations per min., and as a result of the change in section mentioned, the cast form is lighter than the fully-machined finger. In addition, the material now used has better wear-resisting properties than the heat-treated gauge plate. This characteristic is of considerable importance, because the component is located in a somewhat inaccessible position on the machine.

Grateful acknowledgement is made to the Molins Machine Co., Ltd., for permission to publish in this article photographs and details of the various parts seen in Fig. 8 to 11, inclusive.

PRODUCING WAX INJECTION DIES FROM STRICKLED PLASTER MOULDS

Although the lost wax investment casting technique is extremely effective for producing accurate castings of difficult three-dimensional forms in general, and of turbine blades in particular, a considerable amount of time and money may be expended in the production of the accurate master model from which the wax injection die is made. The most difficult shape to reproduce on the master model of a turbine blade is usually the aerofoil portion. This portion, however, generally consists of a form which can be generated by a number of straight lines drawn between two or more templates, which represent the various sections of the required blade. Advantage has been taken of this fact by Trucast, who have developed a method of producing plaster half-moulds for casting wax injection dies, in which the aerofoil section of the blade is formed by strickling the plaster in conjunction with suitable templates. With this process, the necessity of producing a master model

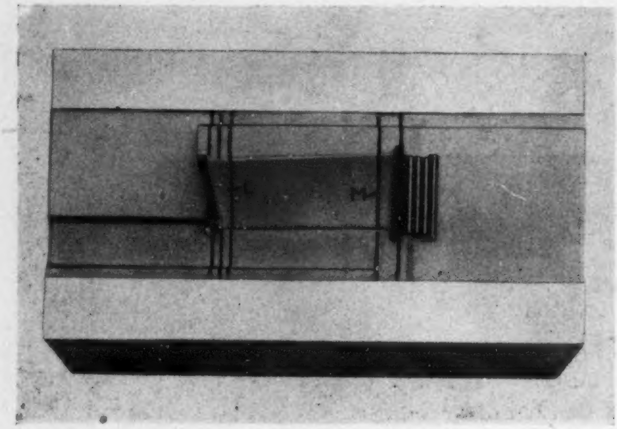


Fig. 12. Typical hard plaster mould for producing one half of a wax injection die. Brass models are used as patterns for the root fixing and tip portions, and the blade portion is produced by a strickle board in conjunction with the templates *L* and *M*

of the part required is completely eliminated.

A mould for a 2-section blade is shown in Fig. 12, where the tip and root templates are indicated at *L* and *M* respectively. In conjunction with these templates, a strickle board has been used to produce the concave side of the aerofoil section. A similar procedure is employed to produce the mating half-mould, which contains the convex side of the blade, great care being taken to provide accurate locations so that the half castings will match on assembly. The mould casing is of built-up construction in steel, and brass patterns of the root fixing and tip portions are located in the plaster, in the correct relationship to the aerofoil section, by the additional templates seen to the left and right of the templates *L* and *M*, respectively.

The templates are filed to shape in position in a special shadow-type projector, designed and built by the company, with which are used accurate line drawings of the aerofoil sections, supplied by the customer. Depending on the size of the turbine blade, these outlines are drawn either 10 or 20 × full size. The bottom face of each template has a locating shoulder which abuts a similar lengthwise projection machined in the floor of the mould box, thereby ensuring that all the templates are located accurately in the transverse direction. Spacing bars are used to set the templates at the required centres, and the complete pack is then locked together by clamping screws provided in the end faces of the mould box.

When the plaster moulds have set, a bismuth/tin alloy casting is made from each, under pressure, and these castings are subsequently joined to produce a complete wax injection die. It is stated that with this procedure, a wax injection die for a turbine blade of average complexity can be produced in 60 to 75 man/hours, whereas more time than this is frequently required to produce a master only with the conventional methods of manufacture.

"Rapid" Deep-field Circular Lifting Magnet

The circular lifting magnet shown in the accompanying figure has been developed by Rapid Magnetic Machines, Ltd., Lombard Street, Birmingham, 12, and is intended primarily for applications where space is limited, as in the loading and unloading of railway wagons, also in instances where the load to be lifted has a limited response to magnetic induction. This magnet has a deep field, and it is stated that, depending on the nature of the load, it is capable of lifting a weight up to 100 per cent greater than is possible with a conventional electro-magnet of equivalent diameter.

Of 46-in. diameter, the magnet here shown is employed for slag handling, and is capable of lifting masses of iron-bearing slag up to 3 tons in weight, or "skull cracker" balls up to a maximum of 9 tons. It can be used in all applications where conventional magnets have been hitherto employed.

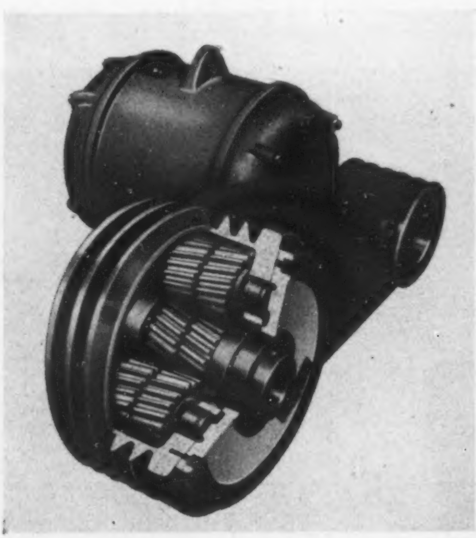
"Rapid" 46-in. diameter deep-field circular lifting magnet

Andantex Speed Reduction Pulleys

The sole licensees for the manufacture and distribution of Andantex speed reduction pulleys in the United Kingdom and Commonwealth countries are Furnival & Co., Ltd., Reddish, Stockport. A cut-away view of one of the pulleys, connected by V-belts to a driving motor, is shown in the figure.

Of compact design, the pulleys are intended for direct mounting on shafts, and speed reduction is obtained by built-in epicyclic gearing. They are available in 16 sizes for transmitting up to 80 h.p., and various arrangements of epicyclic gears can be incorporated to give 21 different speed reduction ratios, ranging from 2·79 to 1 up to 273 to 1, when the pulley and the driven shaft are rotated in the same direction. Reduction ratios from 1·79 to 1 up to 272 to 1 can be provided when the pulley and shaft are driven in opposite directions.

A central cavity in the pulley forms an oil bath and houses the helical reduction gears, which are made from nickel-chrome steel, hardened and precision profile ground. There are two sun gears, one of which is fixed to the hollow driving shaft, the latter being mounted in needle roller bearings. The second sun gear is fastened to a sleeve which surrounds the driving shaft, and is normally prevented from rotating by a torque arm. Drive between the sun gears is transmitted by either two or three pairs of planet gears secured to ball-bearing mounted shafts by a patented keying process which ensures uniform distribution of load.



Cut-away view of an Andantex speed reduction pulley for a V-belt drive

During assembly of the unit, the planet gears are passed over the shafts so that they can mesh freely with the sun gears. The shafts are located, and pre-load is applied to the planet gears by adaptors inserted in the bores in the end-flanges of the pulley, which normally house the bearings. The assembly, which forms, in effect, a mould, is now pre-heated, and keyways provided in the planet gears and shafts are filled with nylon, in liquid form, by a specially-designed injection press. After the nylon has solidified, the adaptors are removed from the pulley, and the bearings are fitted. When the unit is in operation, the slight inherent elasticity of the nylon "keys" ensures that uniform contact pressure is applied between the teeth of the sun and planet gears.

The torque arm is fitted with leaf springs which serve as a safety device and will bend or break when a torque of two to three times that for the rated capacity of the pulley is applied. Release of the sleeve carrying the normally fixed sun gear, as a result of breakage of the leaf spring, automatically disengages the drive to the shaft. Alternatively, a torque arm fitted with a coil spring can be provided. This unit incorporates a pawl which operates a switch to stop the driving motor when a pre-determined torque, up to a maximum of 120 per cent of the nominal rated capacity for the pulley, is transmitted. In the event of failure of these safety devices, shearing of the nylon keys will take place without damage to the gearing when a load of four to five times that for the rated capacity for the pulley is applied.

Other attachments, which are available for mounting on the side of the pulley to form compact assemblies, include mechanical and electro-magnetic clutches, and a 2-speed drive unit.

STOCKS OF PIG-IRON at steel works, steel foundries, and blast furnaces at the end of July amounted to 1,144,000 tons, as compared with 1,039,000 tons at the end of 1957. Stocks of scrap at steel works and foundries at the end of June totalled 1,175,000 tons, as against 1,207,000 tons at the end of 1957.

New B.M.C. Body Painting Plant

Expansion now taking place within the British Motor Corporation will provide for an increase in production capacity of 30 per cent during the next 12 months. These latest developments will cost £18 million, which is additional to the £22 million that has already been invested in new factories and equipment during the past three years. More than 500,000 B.M.C. vehicles of all types were produced in 1957/58, which is stated to be the highest figure yet achieved by any British or European manufacturer, and export deliveries were 16 per cent greater than in the previous year. It is estimated that nearly 45 per cent of the cars sold in Great Britain were the products of the British Motor Corporation.

An important development at the Cowley works of Morris Motors, Ltd., is a new body painting plant which has been built at a cost of £3 million, and is considered to be one of the most efficiently planned units of its kind yet put into production. The new building has a length of 1,400 ft. and it houses two independent production lines arranged side by side, each of which is capable of handling 26 bodies per hour. Alongside these two lines is a Rotodip conveyorized installation in which the "white" body shells first receive the Bonderizing anti-rust and corrosion preventative treatment. This Rotodip installation, which is just being brought into operation, will handle 26 bodies per hour, and augments the existing plant at the Cowley works. It has been built by the Carrier Engineering Co., Ltd., and incorporates automatic loading arrangements and various design improvements resulting from the extensive experience of B.M.C. in operating this type of equipment. The Carrier Engineering Co., Ltd., have also been responsible for the construction of an important part of the new paint lines. The layout of the latter, with which this article is principally concerned, is shown in Fig. 2. At the delivery end of the lines, to the right, are provided facilities for carrying out certain finishing operations and for despatching the painted bodies, also for receiving and storing white bodies that are to be treated in the new Rotodip installation.

To conserve space, each paint line is arranged to turn back on itself, and the carrier and the oil-fired stoving ovens are located above the lines on mezzanine floors, as indicated in the layout. Fig. 1 is a view of one of the lines looking towards the starting end, and the U-bend of the conveyor, seen in the foreground of the latter illustration, is indicated at X on the drawing, Fig. 2.

The bodies progress along the line mounted on wheeled trolleys of fabricated steel, which are returned from the finishing to the starting end by

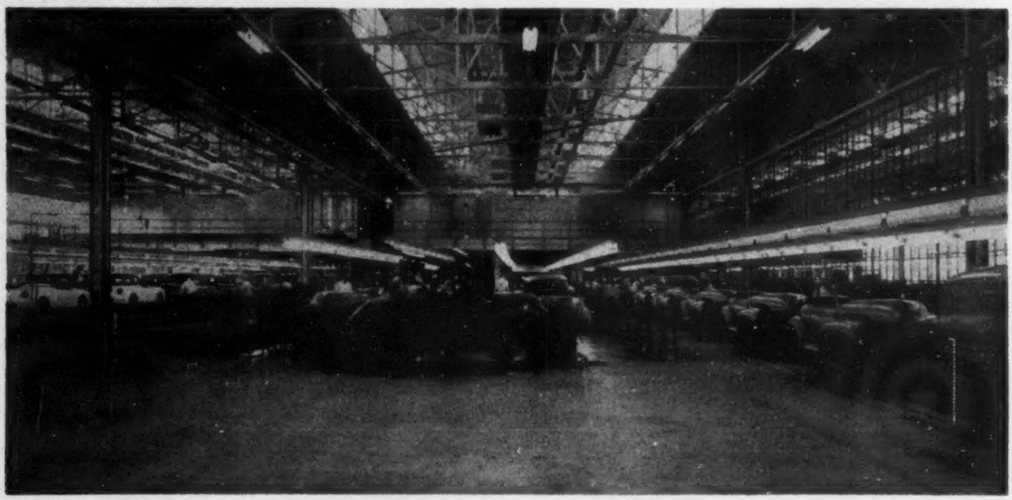


Fig. 1. View of one of the paint lines in the new building

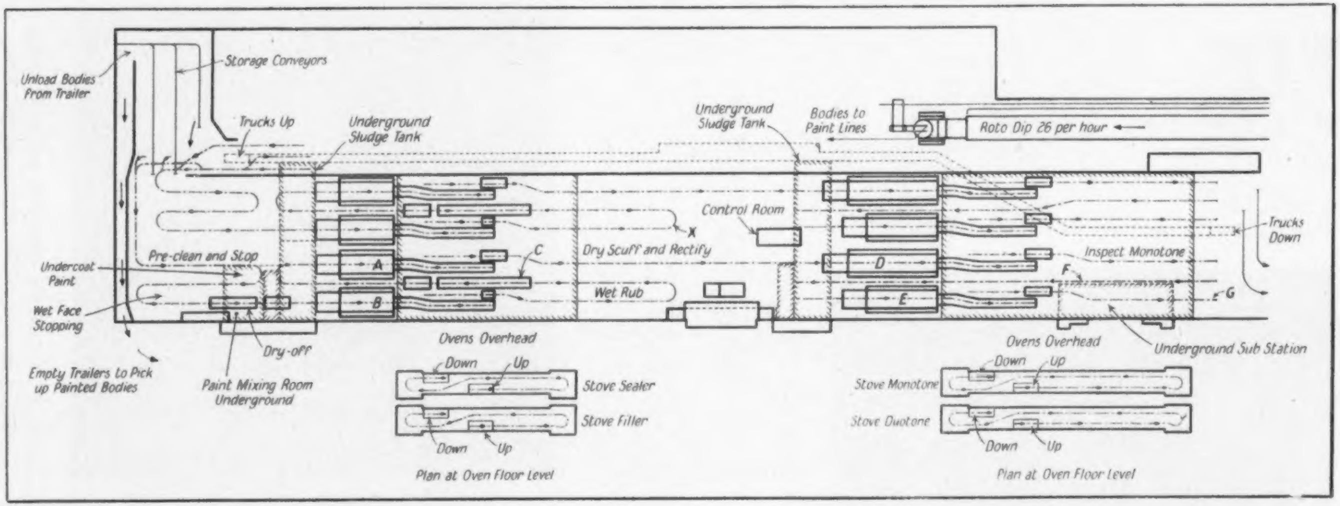


Fig. 2. A diagrammatic layout of the new painting lines at the Cowley works of Morris Motors, Ltd.

way of a train conveyor in an underground passage. A trolley from which a finished body has been removed is seen in Fig. 3, moving down the incline into the passage on its way back to the starting end. One design of trolley serves for all types of bodies handled in the plant, the only adjustment required being for working height. It is the company's intention to provide a cleaning station in the tunnel, and since the trolleys pass through several stoving ovens during the cycle, means will be incorporated for automatically lubricating the wheel bearings.

The bodies delivered from the new and the existing Rotodip installations are loaded by hoist and special sling on to the trolleys, which are then wheeled along guide rails into engagement with the single-chain floor conveyor of the paint line. After preliminary operations, which include cleaning and the application of an anti-drum compound, the body passes through an infrared heated drying tunnel and a cooling tunnel, into the first section of the filler spray booth. Here, a certain amount of hand spraying is carried out, and filler coating is then completed automatically in the second section by means of U.S.-designed Schweitzer equipment, which is now being built in this country by the Carrier Engineering Co., Ltd.

A view from the entry end of a similar Schweitzer booth, in this instance for finish painting, is given in Fig. 4, the bodies seen here being for the Austin-Healey Sprite. Spraying is performed by a total of six guns arranged in two groups of three, each comprising right- and left-hand vertically-traversing guns, and a gantry-mounted gun which moves horizontally above the line. The guns are carried on cam-actuated, pivoted arms whereby they are caused to follow the general contour of the body during the traversing motion. Starting and stopping of the gun traverse and paint flow, as the body enters and leaves the booth, is controlled by photo-electric cell units and light beams.

Stoving of the filler coat is carried out at a temperature of 320 deg. F., and the body is subsequently rubbed down in preparation for applying the sealer, which is sprayed on by hand guns and then stoved

Fig. 3. The trolleys which carry the bodies return to the starting end of the line by way of an underground chain conveyor, as here shown

at a temperature of 300 deg. F. Following a dry scuffing operation, the finishing coat is applied automatically in the booth seen in Fig. 4, to which reference has already been made, and the body is next stoved at a temperature of 275 deg. F. With the latest synthetic finishes that are being employed, no polishing is required after spraying and stoving, and a high degree of durability is provided. In connection with the rubbing down operations, which play an important part in obtaining a high standard of finish, the work is considerably facilitated by the provision of water troughs which are automatically filled, and are heated during cold weather. Where a duo-tone finish is required, the body is suitably masked and the second colour is applied by hand spray guns in a separate booth, as indicated on the layout drawing. This booth is also used for rectifying any bodies which do not conform to the very high standard that is laid down by the inspection department. The finished bodies are unloaded by hoist and special sling from the trolleys, and the latter are pushed along guide rails to the return conveyor seen in Fig. 3.

WATER WASH SYSTEM

All the spray booths are of the water-wash type, and extending transversely across the two paint lines, in a basement, are two 50,000 gal. sludge tanks, one of which serves the filler and sealer spray booths, and the other the finishing booths. A view of one of these tanks is given in Fig. 5. Clean air is circulated through the booth by way of dispersive filters in the roof, and overspray is drawn by the air flow into a water curtain beneath the grid floor seen in Fig. 4. Water and sludge from the various booths flows to the underground tank in a cascade as seen on the left in Fig. 5, and it is recirculated by 12 submersible, motor-driven pumps arranged at the opposite side (to the right in the figure). Additives in the water cause the sludge to float on the surface, and it is skimmed off every day, by manual means, from an electrically-driven trolley that runs on rails extending the length of the tank. The sludge is collected in a detachable skip on the trolley, which is then lifted by hoist to ground level so that it can be towed away for disposal of the contents.

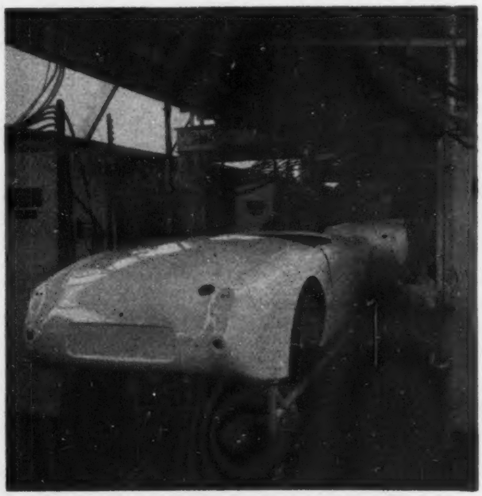


Fig. 4. One of the Schweitzer automatic spray booths for applying the synthetic finishing coat

Fig. 5. De-sludging of the water from the spray booths is carried out in two underground tanks each having a capacity of 50,000 gal.

Submerged water jet pipes, traversed mechanically, prevent the inlet filters of the pumps becoming clogged with sludge, and water is delivered to the floor of the booth, to form a curtain, through downwardly-projecting jet pipes in compartments in the booth sides. The exhaust air passes upwards through these water jets for cleaning purposes, and is then discharged through drying louvres to atmosphere.

PAINT MIXING AND DISTRIBUTION

Primer and sealer paint is supplied by pipe lines to the spray booths of the two production lines from a mixing room in the basement, and there is a similar but larger installation, housed on the upper floor of a 2-storey building, separate from the main shop, for supplying the synthetic finishing paint. A view of the latter plant is given in Fig. 6. Here are installed 26 pairs of mixing pans which enable 26 different-coloured paints to be pumped direct to plug-in supply points in the booths. In the pans, the paint is continuously stirred by paddles, and while one pan of a pair is in use, paint of the same colour is being prepared in the other, so that continuous operation can be maintained.

Thinners is fed to the pans in controlled quantities by way of Wayne flowmeters from an outside storage tank, and each pan holds 100 gal. of paint. About 3,000 gal. of paint are used per week and it is delivered by the suppliers in 40-gal. drums which are stored in specially-designed racks on the ground floor. From the racks, the drums are delivered to the mixing pans by hoist and runway. The building is air conditioned, and incorporates a laboratory from which the operating conditions are closely controlled.

When the colour is to be changed in the spray booth, it is only necessary to flush-out the guns and plug in the pipe connection to the selected paint delivery point. This operation can be performed in 23 sec., and to enable it to be carried out while

Fig. 6. View of the mixing room where synthetic finishing paints of 26 different colours are handled

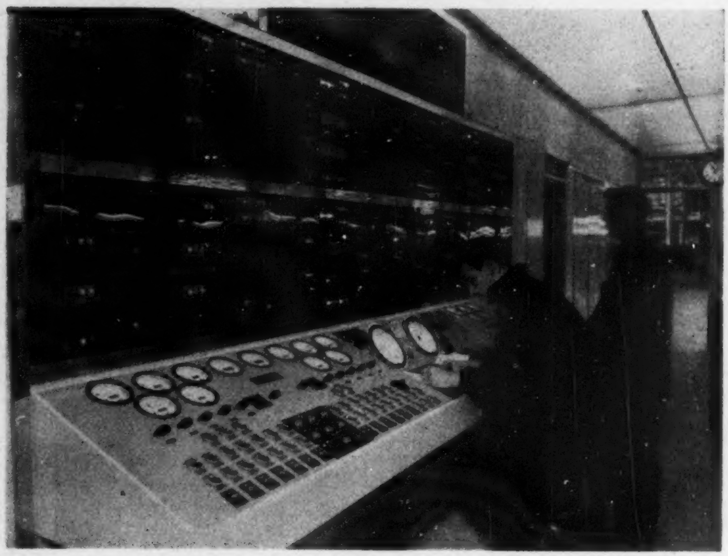


Fig. 7. Centralized electrical control station for the two body painting lines

the bodies are progressing along the line, a double chain conveyor is provided for the finishing booths. The trolley wheels rest on the chain links, as may be seen in Fig. 4, and it is thus possible for the operator to push an incoming body back along the moving chains. In consequence, the change-over can be made before the body interrupts the photo-cell light beams which start the automatic spray guns. The conveyor reverts to single track to carry the trolleys through the stoving oven.

Complete electrical control of the two paint lines is carried out from the centralized station shown in Fig. 7. Here, flow-line diagrams and warning lights on a panel indicate the stopping of any part of the equipment and enable faults to be rapidly located and rectified. Heenan & Froude electro-magnetic transmission units are incorporated in the main conveyor drives, which enable the speed to be closely controlled. Particular attention is drawn to the excellent working conditions and cleanliness provided by the layout of the new plant. An extensive space heating system is installed, and the walls of the building are asbestos lined to facilitate temperature control. A high standard of fluorescent lighting is provided throughout. Safety in the paint mixing rooms is ensured by the provision of fire-proof doors and carbon dioxide sprays which are brought into operation by thermostatic control.

In connection with B.M.C. expansion, reference may also be made to a completely new paint shop which is to be built at the Longbridge works of the Austin Motor Co. and to an important extension of the car assembly building at this plant. The production of replacement engines and gearboxes for B.M.C. cars is now centralized at the original Riley works, Durbar Avenue, Foleshill, Coventry, under the control of Morris Motors, Ltd., Engines Branch, Courthouse Green, Coventry. The plant, which includes five assembly lines transferred from the Austin and Morris factories, is capable of handling 4,000 engines per week by flow-line methods. All used engines and gearboxes received into the factory are completely stripped and the parts are cleaned and thoroughly inspected before they are delivered into stores, or passed forward for re-machining. On the assembly lines, the methods employed for building and testing conform to those for new engines and gearboxes, and units are periodically dismantled and checked by the inspection department to ensure that the high quality specified is being maintained. It is stated that replacement units can be supplied for most of the Austin and Nuffield vehicles on the roads today.

New Lead Alloy for Chromium Plating Tank Linings—British Lead Mills, Ltd., Byron House, 7-9, St. James's Street, London, S.W.1, a member company of the Firth Cleveland Group, announce that, following a " small but increasing number of inexplicable failures in chromium plating tank linings ", they have introduced a new alloy for this purpose with the registered trade name Antatac R.1. It is stated that in connection with this development more than 200 different alloys were made up. The most promising of these alloys were subjected to rigorous tests, during which accepted rules for the protection of linings were deliberately broken. Antatac R.1 is now available in the form of sheet for linings, pipe for heating and cooling coils, and anodes. It is being employed in the new plating plant of Vauxhall Motors, Ltd., at Luton.

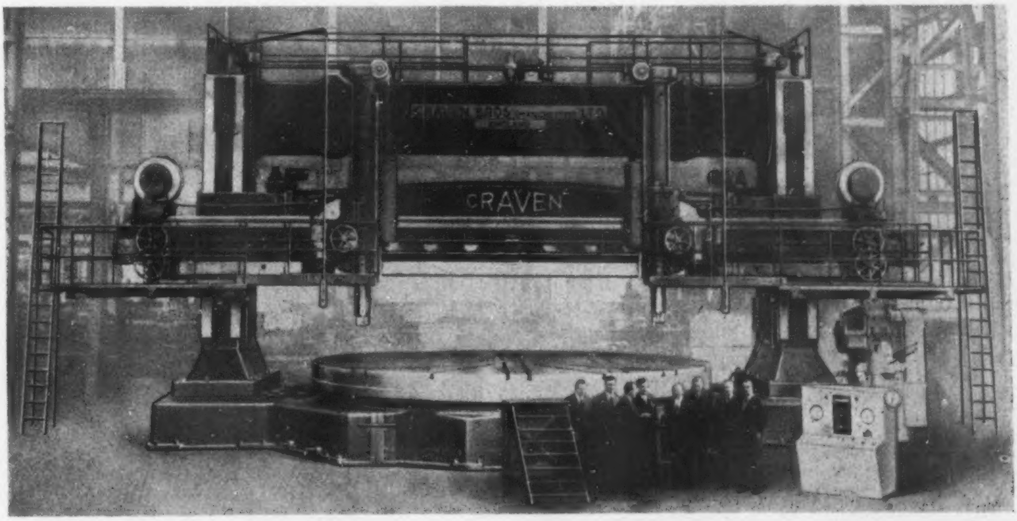
New Production Equipment

Craven 30-ft. Vertical Boring and Turning Mill

Craven Brothers (Manchester), Ltd., Reddish, Stockport, have recently built the 30-ft. vertical boring and turning mill, here shown, for the Australian State Dockyard, Newcastle, New South Wales. In order to handle the general run of workpieces, extending up to 15 ft. diameter, also to cater for occasional workpieces of 30 ft. maximum diameter, the design is based on a 25-ft. fixed-column mill, with a 22-ft. diameter table, but the two columns are supported on bed wings, and the cross-slide and top beam have been extended to accommodate a maximum diameter of 30 ft. 3 in.

Drive is taken from an 80-h.p. variable-speed reversing motor, through V-belts and a 3-speed gearbox, and a table speed range of 0·25 to 7·5 r.p.m. is provided. Two steel pinions are employed to transmit the final drive to a large-diameter, single-helical steel gear-ring, secured to the underside of the table. The two pinions are located at the rear of the machine, on radii 90 deg. apart, and are mounted on vertical shafts in the bed. These shafts are driven from the main gearbox through a central distribution box, at the rear of the bed, and spiral bevel gears. Provision is made for setting the pinions so that the total driving load is equally distributed between them. Built in three sections, securely jointed together, the bed is provided with special levelling screws and plates. The table is of similar construction and has eight pairs of T-slots for the attachment of loose jaws. A central cast-iron spindle, of hollow conical form, is secured to the table, and runs in phosphor-bronze bearings which can readily be adjusted vertically to control the running clearance.

The vertical load of the table and workpiece is supported by two flat, concentric tracks, with phosphor-bronze bearing pads, mounted on top of the bed. Both the spindle and tracks are housed in oil baths, and additional pressure oil lubrication is



Craven 30-ft. vertical boring and turning mill for Australia

provided direct to the various bearing faces by two independently-driven pump units with separate oil supply reservoirs.

Electrical interlocks ensure that table cannot be rotated unless the oil is circulating, and pressure gauges and filters are included in the various oil circuits. A coloured light indicates that the lubricating system is working, and if any failure occurs in the pump motors or oil supply system, the main drive motor is stopped automatically. The oil temperatures at eight different positions in the tracks and spindle bearings are indicated successively by a dial on the control desk. If the oil temperature at any position exceeds a predetermined value, an alarm bell rings and warning lights on the control desk are illuminated.

Each cross-slide saddle has a balanced octagonal-section ram, fitted with a forged-steel tool-holder, which is adjusted vertically by means of a central screw. The ram can be swivelled through an angle of 30 deg. on either side of the vertical position, and has a travel of 5 ft. 6 in. Hand adjustment of the ram vertically, or its saddle horizontally, is effected by separate handwheels at the end of the cross-slide, or by a single handwheel and lever-operated selection clutch on the front of the saddle.

Separate gearboxes at the ends of the cross-slide are provided for the feed and rapid power traverse motions for the two saddles, and the 12 rates of horizontal and vertical feed range from 0·007 to 0·376 in. per rev. of the table. Drive to each feed box is taken from a separate motor, which is also used for rapid traverse, and feed changes are effected by levers on the gearboxes.

When the motors are used to power the feed motion, they receive their electrical supply from a generator coupled to the output shaft of the main drive gearbox. In consequence, variations in the table speed cause modifications in the output voltage from the transmitter and corresponding variations in the speed of the feed motors. By this arrangement, a constant rate of feed per revolution is maintained, regardless of any change that may occur in the speed of the table. It is also possible to accelerate one feed motor from rest while the other feed motor is in operation. When the motors are used for the rapid power traverse they are automatically connected to the fixed-voltage A.C. mains supply and run at a constant speed.

A 35 h.p. constant-speed motor on the top tie beam powers the elevating mechanism of the cross-slide, and the latter can be locked to the columns by separate motor-operated clamping units. An electrical interlock ensures that the main motor is not started until the cross-slide is locked. The electrical equipment is controlled from a desk-type panel, which includes a tachometer for indicating the table speeds, and an ammeter. Controls for the main motor and the appropriate feed motor are also incorporated in each saddle, and in two push-button stations, suspended from arms that are pivotally mounted on the tops of the main machine columns.

The variable-speed main drive motor has a three-to-one speed ratio and operates from 220-volt D.C. supply, derived from a constant-speed motor-generator set, powered by the normal A.C. workshop supply mains.

Birfield-Somua Type Z1B Milling Machine

The Somua Z1B milling machine shown in the accompanying Fig. 1 and 2 is now being built in this country by Birfield Tools, Ltd., Bodmin Road, Coventry, under licence from the French firm Saviem L.R.S.

This milling machine incorporates patented design features which are claimed to afford important advantages, in respect of rigidity, as compared with a conventional knee-type machine, and it is stated that more than 3,000 have been built since it was introduced in 1954. Referring to the diagram, Fig. 3, the 47¼- by 11¾-in. table *A* moves longitudinally in long guideways in a bridge casting *B*, which, in turn, is bolted to the machine base, and in this manner a very rigid support is provided.

Below the table guideways in the bridge, which has extensions at the rear, there are transverse dove-

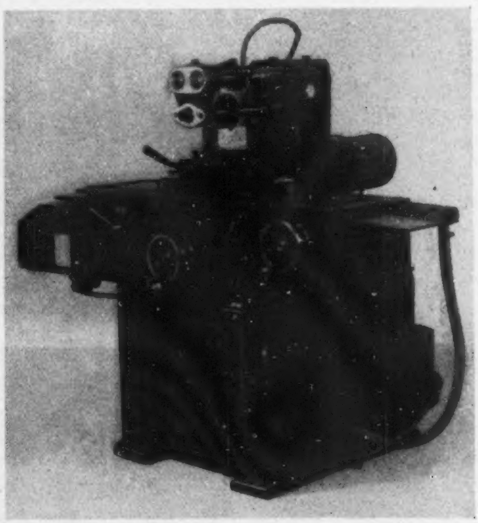


Fig. 1. Birfield-Somua type Z1B milling machine set-up for horizontal milling

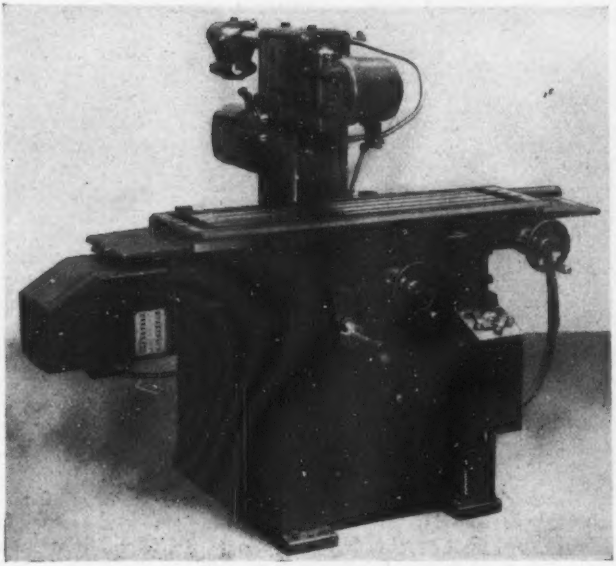


Fig. 2. Birfield-Somua milling machine fitted with a universal swivelling spindle head

tail ways *C*, for the knee *D*, the latter being fully supported at all positions of its movement. Vertical ways at the rear of the knee accommodate a box-section spindle column *E*, which houses the gearbox, the latter being driven by a flange-mounted 3-h.p. motor.

A longitudinal travel of 28 in., a cross traverse of 9¾ in., and a vertical hand adjustment of 15¾ in. are provided. There are nine rates of power feed from ½ to 20 in. per min., and fast traverse at the rate of 80 in. per min., longitudinally and transversely, in addition to hand adjustments by conveniently-placed wheels. The feed and rapid traverse motions are driven by a ½-h.p. motor, which, together with the gearbox, is housed in the left-hand end of the bridge casting. Automatic trip dogs, stated to operate to an accuracy of 0·0004 to 0·0016 in. according to the rate of feed, are fitted, and a backlash eliminator can be incorporated, to enable climb milling to be performed.

Twelve speeds, from 50 to 2,500 r.p.m., in forward and reverse directions, are available for the horizontal spindle, and a heavy-duty vertical spindle head, with speeds from 40 to 2,000 r.p.m. can be fitted. In addition, there is available an inclinable vertical spindle head, a slotting head and a universal swivelling head, the latter being seen fitted to the machine in Fig. 2. Provision is made for the use of an overarm brace when the horizontal spindle is in use. For production applications, the machine can be equipped for a wide variety of automatic cycles, including starting and stopping of the spindle, and combinations of longitudinal and transverse table movements.

A coolant pump and tank are incorporated in the base casting, together with a chip tray, which can be withdrawn from the front. The machine is also available as the type Z1B-ALU, with feed rates ranging from 24 to 80 in. per min., and a rapid traverse of 120 in. per min., for machining light alloys and plastics.

The Somua Z3 milling machine which is also available is of the same general design. Weighing 2 tons 3 cwt., it has a 63- by 14¾-in. table, and a 10-h.p. spindle-drive motor.

In addition, there is a Somua Z44 duplex, bed-type production milling machine, which has a 78- by 16½-in. table and is hydraulically operated.

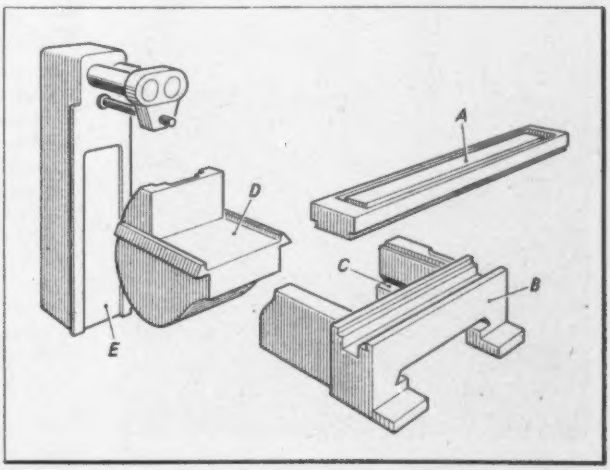


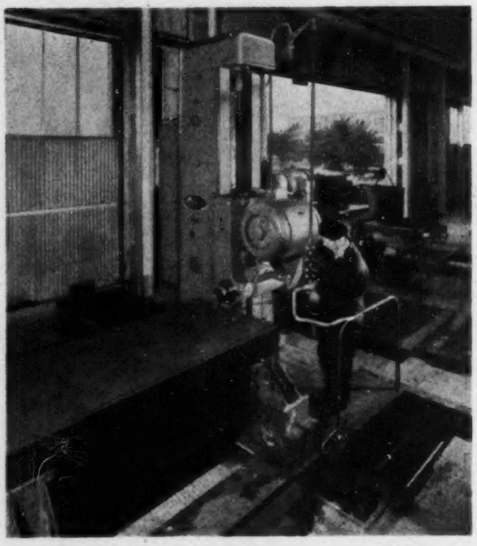
Fig. 3. Diagram showing the construction of the Somua type Z milling machine

Asquith Horizontal-spindle Milling Machine for Facing the Ends of Girders

A horizontal-spindle, floor-type milling machine recently built by William Asquith, Ltd., Halifax, for facing the ends of fabricated steel girders, is here shown installed in the works of Dawnays, Ltd., Welwyn Garden City, Herts. The box-section girders, which are of considerable length, are supported by cross rails attached to floor-mounted rails provided by Dawnays, Ltd.

The facing operation is performed by a Prolite Futur-Mill (Protolite, Ltd.) face milling cutter fitted with octagonal tungsten carbide blades. This cutter is held in the $5\frac{1}{16}$-in. diameter spindle nose by a drawbolt. Drive to the spindle is taken by V-belts from a 20-h.p. motor, and interrupted cutting, also the removal of weld scale, can be undertaken. Spindle speeds of 655, 760 and 870 r.p.m. are obtained by interchangeable pulleys, and the motor can be moved on the spindle slide by screws for adjusting the tension of the V-belts. The spindle quill can be moved axially through a distance of 3 in., by means of a crank, and a micrometer dial is provided to facilitate setting the depth of cut. Upon completion of the setting operation, the spindle quill is secured by a clamp.

The substantial spindle slide is counterbalanced by a weight housed in the box-section, internally-ribbed, column, and has a travel of 6 ft. on broad guideways. Taper gibs and keep strips, also wipers for the column ways, are incorporated in the slide. The column base has a horizontal travel of 10 ft. on the bedways, and telescopic guards are fitted to prevent the ingress of swarf to the guiding surfaces. The bedways are automatically lubricated by a motor-driven pump, which has provision for adjusting the rate of delivery of the oil. Horizontal and vertical traverses are derived from separate 3-h.p. 2-speed motors, through rotating nuts and fixed screws, which are held in tension when the column base and the spindle slide are being traversed in either direction. Feeds of 30 and 60 in. per min. are usually employed for both the column base and spindle slide, but interchangeable pairs of pulleys are supplied which enable rates of 40 and 80 in. per min. to be obtained.



Asquith horizontal-spindle, floor-type milling machine for facing operations on the ends of fabricated steel girders

The various motions of the machine are controlled by push-buttons mounted on a swivel pendant unit, and an injection braking system is provided for the spindle drive and feed motors so that they can be "inched" to facilitate setting. A wattmeter is fitted to indicate the load on the spindle drive motor when cutting is actually in progress.

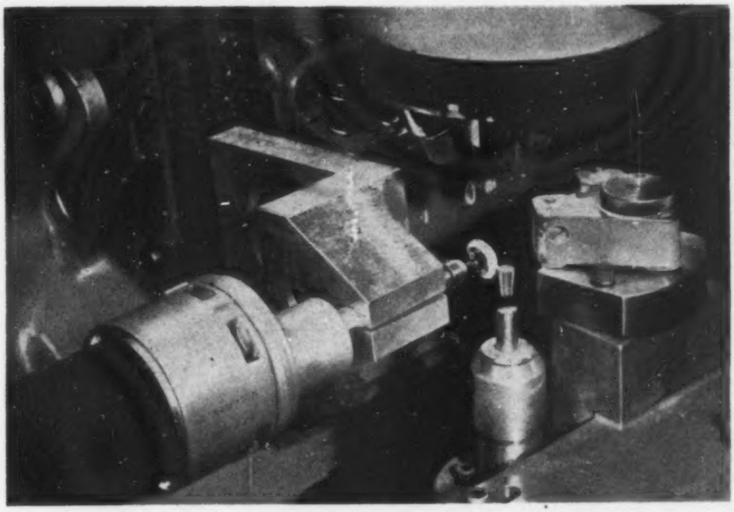
Weighing approximately 9½ tons, the machine occupies a floor space of 20 ft. 6 in. by 5 ft., and has an overall height of 13 ft. 9 in. Machines built by William Asquith, Ltd., are sold by Drummond-Asquith (Sales), Ltd., King Edward House, New Street, Birmingham, 2.

New Small Wheel Attachment for the Wickman Optical Profile Grinder

In the figure is shown a high-speed spindle attachment recently introduced by Wickman, Ltd., Tile Hill, Coventry, for use with their optical profile grinder.

Available with different driving motors for operation on single-phase supplies of 110 and 220 volts, this attachment provides a spindle speed of 35,000 r.p.m., under load, and takes wheels from ¼ to ⅜ in. diameter, with ⅛-in. diameter shanks. It is intended for profile grinding, for example, small punches for press tools and core pins for preforming tungsten carbide drawing dies, on which small run-out radii are required. By dressing the wheel to a predetermined diameter, the run-out radius on a core pin, which is reproduced on the entry side of the drawing die during the subsequent forming operation, can be accurately ground simultaneously with the profile grinding of the pin.

The attachment can be readily mounted in place



Close-up view of the Wickman optical profile grinder here shown fitted with the new small wheel attachment

of the standard spindle unit, and there is a special tube for connection to the dust collecting system provided on the machine. When the attachment is mounted on the machine, as shown, the grinding wheel occupies the same position in relation to the work as the larger diameter wheel usually employed.

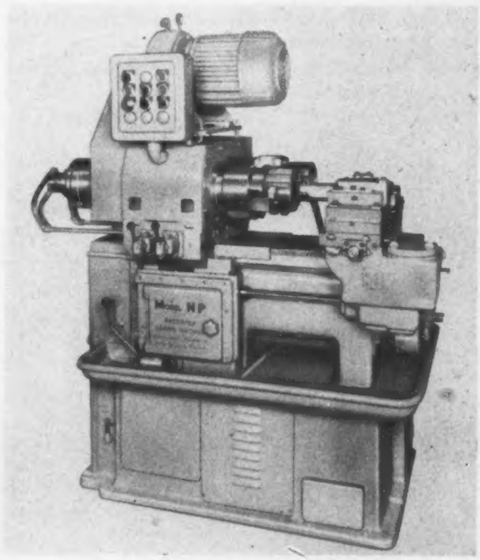
Seneca Falls Precision Boring Machine

The type NP precision production boring machine, here shown, has been added to the range built by the Seneca Falls Machine Co., Seneca Falls, N.Y., U.S.A. Available with single or twin spindles, of the company's own design, the arrangement of the headstock bridge is such that other makes of standardized boring spindles can be fitted, if required. When the company's spindles are employed, a choice of three different designs is available, with maximum spindle speeds of 2,500, 5,000, and 10,000 r.p.m.

On a 2-spindle machine, the spindles can be driven by a single motor, or by separate 3-h.p. motors, where different speeds are required. For either system, the drive is transmitted by V-belts, and the spindles run in high-precision pre-loaded ball bearings.

The table has a maximum traverse of 5 in., and is carried on vee and flat slideways, which are completely covered at all times. A drum-type cam is employed to traverse the table to ensure a positive feed motion and a high surface finish on the workpiece. A patented quick-change mechanism is incorporated for varying the length of the table stroke, and the rapid traverse and feed cycles, within the range quoted, without changing the cam. It is stated that, with this mechanism, the average time required to make an alteration is less than 30 min. The table measures 9⅝ by 19 in., and has a rapid traverse rate of 370 in. per min., the range of boring feeds varying from 0·0005 to 0·054 in. per min.

Boring can be carried out either with the work mounted on the spindles and the tools on the table, or, when it is impracticable to rotate the part, by the reverse procedure. Standard cross-slides, arranged for both hand or



Seneca Falls precision production boring machine

power-operation, are also available. It is stated that boring can be carried out to limits of accuracy that are well within those specified by the aircraft, instrument, and motor car industries.

Gaston E. Marbaix, Ltd., Devonshire House, Vicarage Crescent, Battersea, London, S.W.11, are the agents in this country for the Seneca Falls Machine Co.

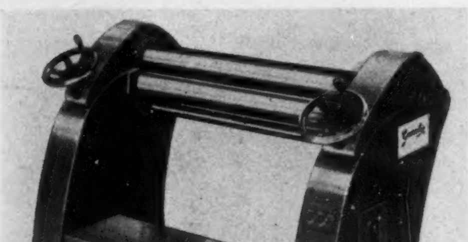
Genelin Plate Bending Rolls

John S. Young & Co., Ltd., Maryville Avenue, Giffnock, Glasgow, are the sole agents for the recently-introduced Genelin plate bending rolls shown in the figure. The subject of a patent application, the machine has a capacity for bending mild steel plates from 39 in. wide by ¼ in. thick, up to 12 in. wide by ½ in. thick, for example. It incorporates 4-in. diameter lower bending rolls, and a 4¾-in. diameter top roll, all of which run in spherical roller bearings.

The entire drive unit is housed in the base, and the shape of the side members of the fabricated steel frame is such that the rolls are positioned at the rear of the centre line, and with this arrangement access to the work can readily be obtained from either side.

The distance from the centre line of the lower rolls to the shop floor is 37⅛ in., and to the top surface of the base, 22½ in.

Adjustment of the top roll is made by separate screws at both ends, and scales and pointers are fitted to facilitate setting for parallelism. The bearing housing at either end of the top roll can be readily swung clear to permit of unloading closed rings and cylinders.



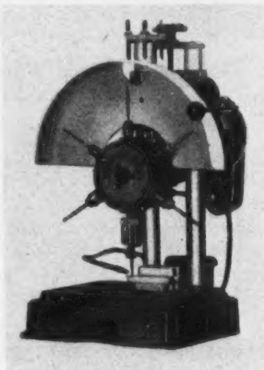
Genelin plate bending rolls

Drive is taken from a 5-h.p. motor, directly coupled to a 3½-h.p. Churchill-Sturm hydraulic unit, thence to the lower rolls by a duplex roller chain and gears. Reversible, steplessly-variable work speeds, ranging from 0 to 100 ft. per min., are thus provided, adjustment being made by levers at both ends of the frame. The lower rolls and their bearings and driving gears can be readily removed from the frame as a single unit.

The machine weighs 19 cwt., and occupies a floor space of 56½ by 26⅛ in.

Burgmaster Turret Drilling Machine with Automatic Indexing

To meet the need for a sensitive machine for use in the production of small delicate parts to close limits of accuracy, the bench-type turret drill shown has been developed by the Burgmaster Corporation, Small Tool Division of Burg Tool Manufacturing Co., Gardena, California, U.S.A. The automatically-indexing turret enables a variety of operations such as drilling, tapping, reaming, counterboring and spot facing to be carried out at one set-up.



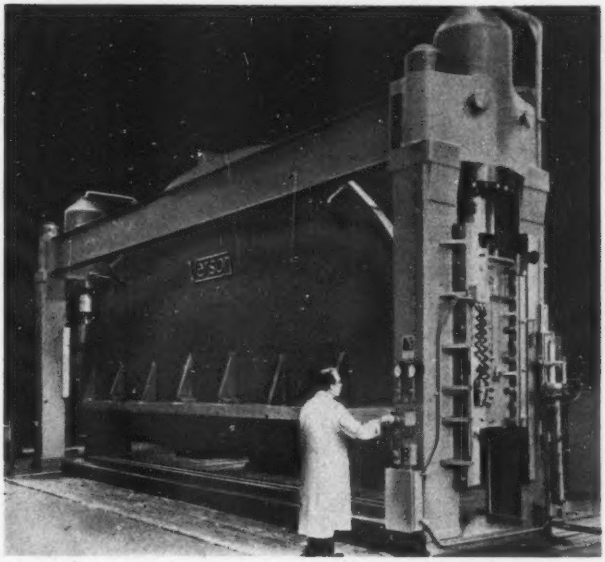
Burgmaster turret drilling machine with automatic indexing

Drive to the spindle is transmitted by 2-step pulleys and a belt, and there are 12 spindle speeds, comprising a high range from 650 to 6,200 r.p.m., and a medium range from 350 to 3,300 r.p.m. The overall dimensions of the machine are 24 in. high by 17 in. wide by 20 in. deep, and the working surface of the table measures 8 by 12 in. A maximum distance of 7¼ in. is obtainable between the end of the chuck and the table, and the spindle has a maximum traverse of 2¾ in. The distance from the centre of the chuck to the column is 5¼ in.

A number of accessories is available for use with this machine, including drill chucks, tapping heads, spindle extensions, a sub-plate, and a cabinet-type mounting complete with a coolant pump.

Verson 1,000-ton Press Brake

The large hydraulic press brake shown in the accompanying figure has been built by the Verson All-steel Press Co., Chicago, Ill., U.S.A., for Hall, Longmore & Co., Ltd., Transvaal, South Africa, and will be employed primarily for the fabrication of steel pipe up to 36 in. diameter by 30 ft. long, for pipeline installations. Of "A"-frame construction, the press is rated at 1,000 tons, measures 31 ft. between the housings, and is stated to be the largest machine of this type yet built.



Verson 1,000-ton press brake

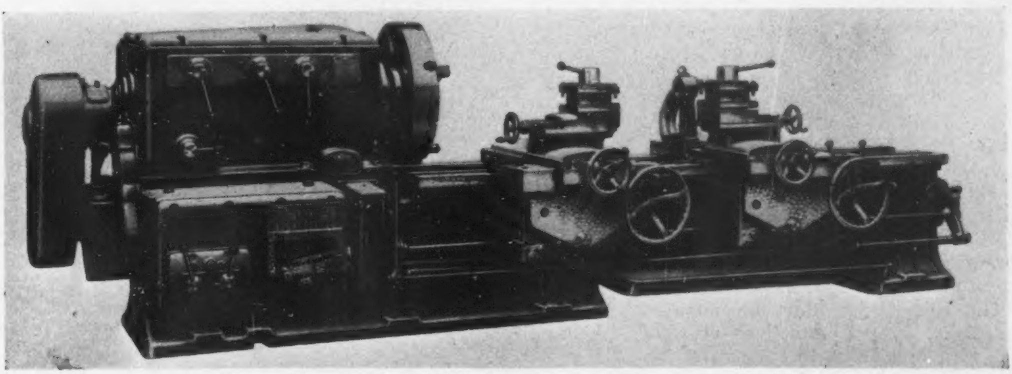
Advance and pressing speeds of 41½ in. per min., and a return speed of 124½ in. per min., are provided, and the press has a ram stroke of 34 in. It was supplied complete with the necessary tooling, which was built by the company, and an automatic levelling control is incorporated. The machine weighs approximately 200 (short) tons, and occupies a floor space of 7 ft. 10 in. by 39 ft. 4 in.

Paul Granby & Co., Ltd., 39 Victoria Street, London, S.W.1, are the sole selling agents in this country for Verson machines.

Crowthorn Heavy-duty Lathe for Facing Crankcases

Crowthorn Engineering Co., Ltd., Atlas Works, Reddish, Stockport, have recently supplied the 31-in. swing, heavy-duty lathe shown in the illustration, for facing, simultaneously, both ends of crankcases for Kelvin marine engines.

Two saddles are mounted on the 24-in. wide bed, and are fitted with top slides of opposite hands, which carry 4-way toolposts. The right-hand assembly carries a bracket for supporting the outer end of a mandrel. Workpieces of 21¼ in. maximum diameter can be swung over the saddle covers. Twelve spindle speeds, ranging from 7 to 300 r.p.m., are obtainable, the drive to the headstock being taken



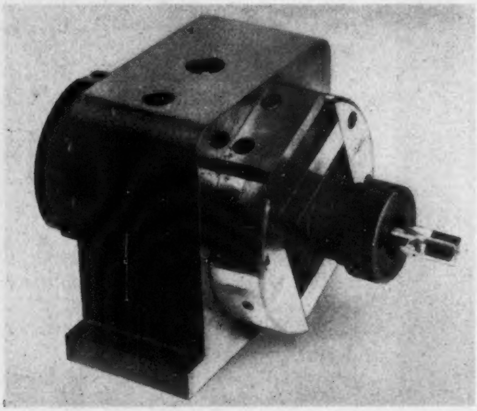
Crowthorn 31-in. swing, heavy-duty lathe for facing both ends of crankcases for Kelvin marine engines

from a 20-h.p. motor. The spindle is bored 4⅝-in. diameter and is mounted in Timken precision taper roller bearings.

The lathe occupies a floor space of 16 ft. 3 in. by 5 ft. 6 in., and weighs approximately 8½ tons.

Rotaform Grinding Fixture

The Rotaform fixture shown in the accompanying illustration has recently been introduced by



Rotaform grinding fixture for punches

Lennie & Thorn, Ltd., Western Road, Bracknell, Berks. The subject of patent application, the fixture is primarily designed to facilitate the grinding of formed press-tool punches from cylindrical blanks, although it can also be employed for light machining operations on copper, for example, as required for the production of electrodes for spark machining. In addition, finished components can be set up in the fixture for inspection.

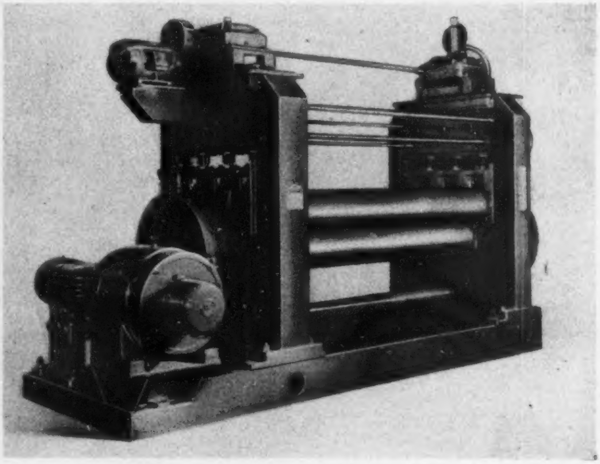
Interchangeable collets for gripping punch shanks from ⅛ to ⅝ in. diameter can be supplied for mounting in the compound workhead, the main and auxiliary slides of which may be moved through distances of ½ and ⅝ in., respectively, and locked. Setting is carried out with slip gauges, and accuracy of 0·0002 in. is claimed. The punch can thus be adjusted radially, in two directions at right angles, in relation to the axis of the spindle that passes through the body of the fixture. Of hardened steel, the spindle can be smoothly rotated through a full turn by means of substantial knob at the rear end, and it can be set for angle, within 5 min. of arc, by reference to a large-diameter vernier scale. Adjustable stops permit the angular movement to be restricted for grinding arcs of different lengths. A wheel dressing attachment is available, and enables radii from 1¼ in. convex to 1½ in. concave to be generated on surface grinding wheels.

With the combination of rotary movement and radial adjustments described, a wide variety of symmetrical and irregularly-shaped sections can be quickly and accurately produced on a surface grinding machine, in the required relationship to the shank of the punch, without re-setting the work in the collet.

Bronx 5-roll Plate Levelling Machine

Bronx Engineering Co., Ltd., Lye, near Stourbridge, have recently built the 5-roll plate levelling machine shown in the figure. It has upper and lower rolls of 12½ in. diameter, and will handle mild steel plates up to 8 ft. wide by ¾ in. thick at a speed of 16 ft. per min.

Drive to the lower rolls is taken from a 50-h.p. reversing motor through a worm gear box and totally-enclosed reduction gearing. The upper rolls can be adjusted simultaneously, by hand, or by a 7½-h.p. reversing motor. Separate handwheels are provided for independent adjustment of the outer rolls, and roll setting is facilitated by large-diameter dial indicators, mounted on one of the substantial fabricated steel columns.



Bronx 5-roll Plate Levelling Machine

Open Days at the A.I.D. Laboratories

With the collaboration of the Inspectorate of Electrical and Mechanical Equipment, and the Chemical Inspectorate, the Aeronautical Inspection Directorate held Open Days at the Harefield Laboratories, for the first time, on October 8 and 9. The laboratories of the A.I.D. were founded in 1914, and orginally occupied a small building at Farnborough. One year later, additional laboratories were opened at Sheffield and London, specifically for the testing of metallic and non-metallic materials. As the work of the Directorate widened to cover the fields of gauge and electrical equipment testing, it was decided to centralize the separate laboratories. Accordingly, in 1919, activities were transferred to Kidbrooke, where they remained until 1936, when the work of the organization was expanded still further, to include metrology, metallurgy, and radiology. This expansion necessitated a move to premises at the Royal Airship Works, Cardington, where the Directorate remained until the present modern laboratories at Harefield were ready for occupation in 1940.

The work of the A.I.D. at Harefield is divided into six sections, concerned with metallurgy, metrology, non-destructive testing, guided weapons, textiles, and apprentice training. In addition, there are physics and radio sections of the I.E.M.E., and a section of the Chemical Inspectorate. The functions of the establishment are three-fold, namely, to ensure the maintenance of the high quality of supplies by the application of precision measuring equipment and the development of new inspection techniques; to collaborate with industry on methods for precision testing, the investigation of failures, and the improvement of inspection techniques in general; and to act as a training centre for A.I.D. staff by providing regular courses of instruction. Considerable importance is attached to the degree of collaboration which can be achieved with industry, and whilst, on average, 200 representatives from firms visit the laboratories annually to discuss specific problems, it is felt that this figure could be usefully increased, and it is hoped that the inauguration of Open Days will indirectly assist in the attainment of this objective.

WALL THICKNESS MEASUREMENT

An example of the work of the metrology department in connection with the development of new measuring techniques is afforded by the wall thickness measuring equipment shown in Fig. 1 and 2. Although the equipment is here shown set up for measuring the wall thickness of a fairly large diameter copper tube, the original problem was to develop a means of taking such measurements on a component which had a fairly small non-circular bore extending through its entire length of 27 ft. The equipment comprises a channel-section steel beam on which is mounted, at one end, a standard alignment telescope and an optical micrometer, as indicated at *A*. Immediately in front of the telescope, there is a swivel mounting *B* for one end of a 1¼-in. diameter copper tube, the other end of which serves to hold the

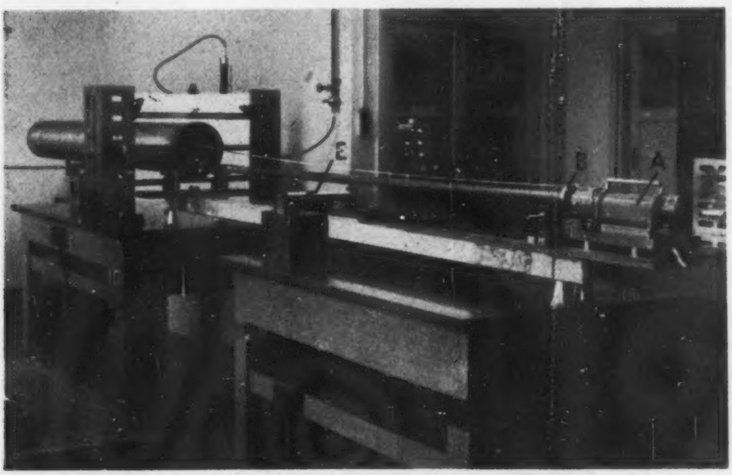


Fig. 1. Equipment developed by the Metrology Department of the A.I.D. laboratories at Harefield for measuring the wall thickness of hollow components with circular or non-circular cross sections

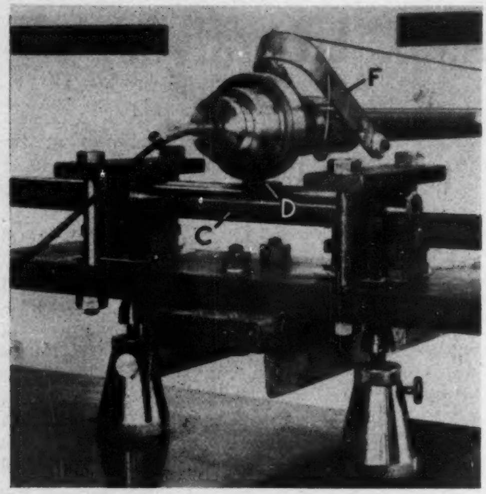


Fig. 2. Close-up view of the stylus head of the wall-thickness measuring equipment seen in Fig. 1. The stylus is a standard ball bearing with the outer race ground to a spherical form

"stylus" and a target graticule. The stylus is actually a standard ball bearing, the outer race of which has been spherically-ground to provide for point contact with the surface of the workpiece being measured. A close-up view of the stylus and its carrier tube is shown in Fig. 2, where the ground cylindrical anvil which serves as the fixed measuring datum can be seen at *C*. The centre line of this anvil is arranged exactly beneath the centre of the ball bearing sphere. A light source is provided to illuminate the target in the stylus head, power for this lamp being supplied by way of the cable at the left.

To measure a workpiece, the optical micrometer is first set to zero with the stylus head resting on a stack of slip gauges equivalent to the nominal wall thickness of the part, in the manner shown in Fig. 2, where the slip gauge is indicated at *D*. Next, the slip gauge is removed, the stylus head is raised, and the component is placed in position, with the outer end resting on a pair of free-running rollers and the opposite end in contact with the anvil *C*. The stylus is then lowered into contact with the bore of the part, and any variation in wall-thickness of the latter from the nominal has the effect of raising or lowering the stylus from the datum position. Since the target graticule is integral and coaxial with the stylus head, its horizontal hair line is displaced above or below the zero mark of the alignment telescope, and the amount of such movement can be read directly by the inspector with the aid of the optical micrometer.

A series of readings can be taken along the workpiece by moving it lengthwise towards the telescope, and when the outer end has passed beyond the free-running rollers, the leading end is supported on the ground bar indicated at *E*, Fig. 1.

Immediately behind the stylus head, there is a U-shaped pivoted bracket, seen at *F* in Fig. 2, which has a free-running roller mounted at the end of each leg. To avoid a rubbing contact between the stylus and the workpiece each time the latter is traversed forward for a fresh reading, this bracket can be pulled into the vertical position by means of a thin-gauge wire attached to the top. As a result the rollers make contact with the workpiece and the stylus head is lifted clear. When readings have been taken along the entire length of the work, the latter can be rotated through any required angle, and the procedure repeated.

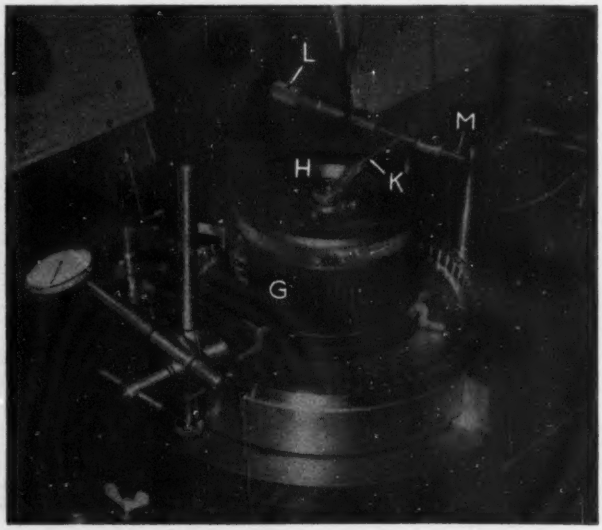


Fig. 3. A small dividing head which has been designed and built by the A.I.D. for checking the angular errors of electrical synchros for aircraft and guided missiles

DIVIDING HEAD FOR TESTING SYNCHROS

With the increasing use of synchros for transmitting information regarding the angular positions of components in aircraft and missiles, means have had to be found for checking the angular errors which are inherent in the synchro itself, that is, the amounts by which the rotor shaft positions differ from the true electrical positions. For this purpose, the A.I.D. has designed and built the small dividing head shown in Fig. 3, with which the body portion of the synchro can be set to the required angle, relative to the datum, within 15 sec. of arc, and any positional error of the rotor shaft measured directly by micrometer.

The body portion of the synchro is held in the freely-rotating member *G*, so that the rotor shaft projects, as at *H*. At the lower end of the member *G* there is an annular track which contains 72 closely-packed ⅜-in. diameter rollers. These rollers serve, in effect, as index notches, and the peripheries of any two can be engaged by a ball-ended plunger which is attached to an arcuate adjustable slide on the base of the instrument. When a synchro is received from the maker, it has a small line marked on the end face of the rotor and a similar line on the body portion, and when these two lines are coincident the mechanical and electrical positions of the unit are approximately at zero. With the synchro aligned in this manner, the arm *K* is clamped to the rotor shaft, and its outer end is introduced between the anvil of the micrometer *L* and the spring-loaded plunger *M*, the micrometer being set to zero or some convenient figure.

Current is now supplied to the windings of the synchro, and the arcuate slide carrying the indexing stylus is adjusted to rotate the member *G* until a null reading is obtained on an associated instrument. The arm *K* is, of course, held stationary during this movement by the micrometer and the plunger *M*, with the result that the body of the synchro and the rotor shaft are now truly aligned. Next, the member *G* is indexed through 5 deg., the distance between the centres of two rollers. The anvil of the micrometer is then retracted, and the plunger *M* rotates the arm *K*, and, consequently, the rotor of the synchro, while the body portion of the latter remains stationary. This adjustment is continued until a null reading is again obtained on the associated electrical instrument. The difference in the micrometer readings is noted, and since the length of the arm *K* is such that 0·001 in. movement of the micrometer anvil represents 1 min. of arc, this linear adjustment can readily be converted into angular movement. The maximum error of angular position specified for these synchro units is approximately 4 min. of arc.

A branch of the Ministry of Supply student apprentice training scheme has been in operation at Harefield since 1953, the annual intake of 10 students being recruited through the Civil Service Commission. The training occupies five years, and starts with two years' instruction in the workshops. Laboratory training is given in the third and fourth years, and the fifth year is spent at an aircraft firm, to gain industrial and production experience. A small display of some of the tools and equipment made by the students during the course of their training was on view during the Open Days.

Coming Events

North East Coast Institution of Engineers and Shipbuilders. October 31, at 6.15 p.m., in the Lecture Theatre of the Literary and Philosophical Society, Newcastle-upon-Tyne; Andrew Laing Lecture on "Nuclear Power for the Propulsion of Commercial Shipping," by Sir John Cockcroft, O.M., K.C.B., C.B.E., F.R.S.

The Institute of Metal Finishing. *Sheffield and North-East Branch.* October 31, at 7 p.m., at the Grand Hotel (Fitzwilliam Room), Sheffield; lecture on "Recent Developments in Polishing Techniques," by J. H. Bryan.

Incorporated Plant Engineers. *South Wales Branch.* October 28, at 7.30 p.m., at the South Wales Engineers' Institute, Park Place, Cardiff; lecture on "The Clean Air Act and Effluents," by A. S. Minton. *Birmingham Branch.* October 31, at 7.30 p.m., at the Imperial Hotel, Temple Street, Birmingham; lecture on "The Clean Air Act."

Institution of Electrical Engineers. *Southern Centre.* October 31, at 6.30 p.m., at the South Dorset Technical College, Weymouth; paper on "Three Weeks in the U.S.S.R.," by Sir Josiah Eccles, D.Sc. *London Measurement and Control Section.* October 28, at 5.30 p.m., at the Institution, Savoy Place, W.C.2; discussion on "Electronic Control of Machine Tools," opened by D. T. N. Williamson.

Institution of Production Engineers. *Manchester Section.* October 27, at 7.15 p.m., at the Manchester College of Science and Technology, Sackville Street, Manchester; lecture on "Zeta," by J. Blears, B.Sc.

Institution of Mechanical Engineers. October 31, at 6 p.m., at the Institution, 1 Birdcage Walk, London, S.W.1; papers on "Estimation of Upper Bound Loads for Extrusion and Coining Operations," by W. Johnson, and "Theoretical Analysis of the Bending of Wide Plates of an Aluminium Alloy in the Plastic Range," by J. M. Alexander. *London Lubrication Group.* October 29, at 6 p.m., at the Institution, 1 Birdcage Walk, S.W.1; discussion on "Can Automotive-type Bearings be Applied More Generally in Engineering?" *Yorkshire Branch.* October 27, at 7 p.m., at the Institute of Technology, Bradford; paper on "Turning with Ceramic and Sintered Oxide Tools," by R. C. Brewer.

Churchill Gear Machines Link-line for Cluster Gears

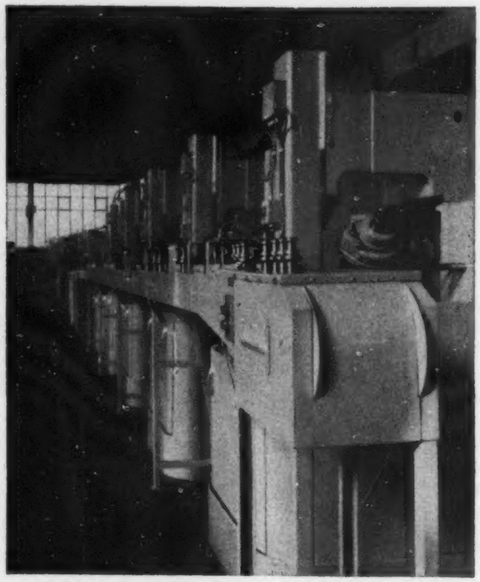


Fig. 1. View from the starting end of the Churchill fully-automatic machine line for producing gearbox cluster gears

Churchill Gear Machines, Ltd., recently demonstrated, at their Blaydon, Co. Durham, works, a 175-ft. long fully-automatic machine line for producing gearbox layshaft cluster gears, which is stated to be the most advanced unit of its type yet produced in Europe. Destined for the British Motor Corporation, this line represents a notable achievement by the company, who have already built in-line arrangements of Rigidhobbers incorporating fully-automatic loading equipment, as described in MACHINERY, 90/269—1/2/57.

A view from the starting end of the line is given in Fig. 1. Operations on the turned cluster-gear blanks start with hobbing the fourth-, third-, and first-speed gears on a line of five Churchill Mk.IV Rigidhobbers, and after the work has been washed and gauged, the second-speed gear is cut on three Fellows-England type 7125A gear shapers built by Alfred Herbert, Ltd. Washing and gauging follows, and the parts then pass to three Churchill-built machines which chamfer the teeth of the second-, third-, and fourth-speed gears. Two machines, also built by the company, perform a rounding operation on the teeth of the first-speed gear at the next stage, after which the work passes through brushing and washing units to a line of four Churchill Red Ring G.C.U. gear shaving machines, which finish all the teeth. The loading and unloading equipment installed between two of these machines is shown in Fig. 2. After shaving, the cluster gears are thoroughly washed in preparation for gauging the teeth, and finally the outside diameters of the teeth of the three

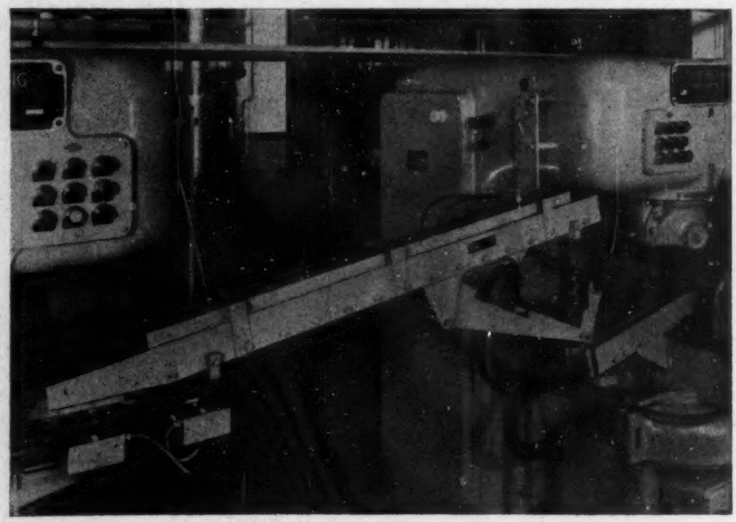


Fig. 2. Work-handling equipment between two of the Churchill Red Ring gear shaving machines

helical gears on the cluster are plunge-ground on a Newall LA machine. These ground diameters provide locations during the subsequent heat treatment operation.

In all, there are 26 units in the line, and although six different types of machine tools are employed, together with washing and gauging stations, the automatic work handling throughout the line is achieved by the use of only two types of automatic loader, and two types of conveyor for the transport of the components from one machine to another.

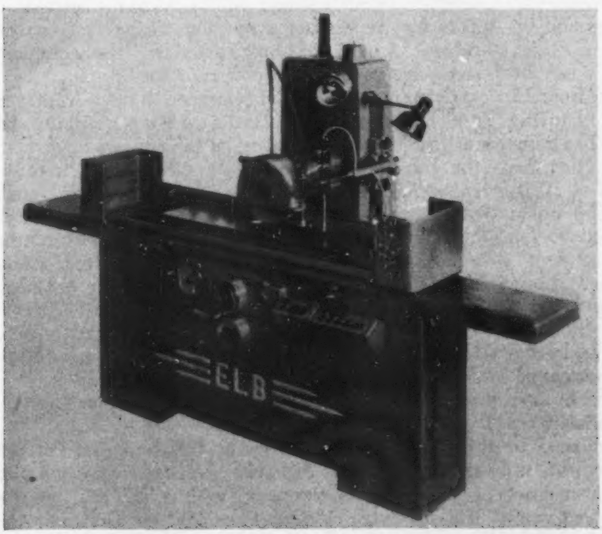
Further details of this noteworthy installation will be published shortly in MACHINERY.

Grinding Machine Demonstration

Examples of grinding machines built by the German firms Wotan, Elb, and Schmaltz, for whom Soag Machine Tools, Ltd., Juxon Street, Lambeth, London, S.E.11, are selling agents in this country, were demonstrated recently at the company's showroom at Hester Road, Battersea, London, S.W.11.

A Wotan type RJ 134/8G hydraulic internal grinder, which was shown in operation, will swing a maximum diameter of 24 in., and has a capacity for grinding bores up to 20 in. diameter to a maximium depth of 20 in. The table which carries the wheel-head has a maximum travel of 32 in., and the steplessly-variable traversing speeds available range up to 26 ft. per min. Cross feed is applied to the wheel-head hydraulically at the left-hand end of the table travel, and shortly before the required bore size is reached, there is an automatic change to finishing feed steps of 0·0001 in. on diameter. The work-head can be swivelled for grinding tapers up to 50 deg., and has a cross adjustment of 12 in. to the rear and 6 in. to the front of the normal position. This arrangement enables the work to be rapidly re-set when a stepped bore is being ground. Face and external grinding, in addition to parallel and taper bore grinding, can be carried out at a single setting of the work, without the need for special equipment. If required, however, a face grinding attachment may be mounted on the work-head. A full description of the machine was published in MACHINERY, 88/1134—22/6/56.

Wotan internal grinders are of unit construction, and can be supplied in different forms for handling a variety of workpieces. A good example of the type of machine which can be provided for a particular requirement was afforded by a type RJ 134/13L internal grinder for handling long workpieces such as headstock spindles for lathes. On this machine the parallel and taper bore, and the face and external diameter at the flanged nose end of the spindle, can be ground at a single setting of the work.



Elb type SW 10 VA hydraulic surface grinder recently demonstrated in the showroom of Soag Machine Tools, Ltd.

The machine is of basically similar design to the type RJ 134/8G, but the work-head is mounted on a swivel table, which, in turn, is carried by a bed extension piece, supported at the left-hand end by a column. Bores can be ground for a maximum depth of 32 in., and distances up to 110 in. are obtainable between the nose ends of the work and grinding spindles.

The range of Elb hydraulic surface grinders was represented by the type SW 6VA 24- by 12-in. machine, and the type SW 10VA, shown in the figure, which has a grinding capacity of 40 by 12 in. A maximum distance of 21½ in. is obtainable between the spindle axis and the work table. This range, it may be noted, has recently been extended to include four new

sizes with grinding capacities from 24 by 20 in. to 79 by 30 in.

In an article published in MACHINERY, 91/1031—1/11/57, in connection with the Hanover Exhibition, reference was made to the principal design features of the Elb machines, and the wide range of equipment which can be supplied. These items include the Forster automatic electronic sizing equipment (which was fitted to the type SW 10VA machine shown at the demonstration), an optical projector for profile grinding, a closed-circuit television system for use when grinding radio-active materials, for instance, a stylus-controlled copy-grinding unit, a wheel-head for slideway grinding, and wheel crushing attachments for mounting on the wheel-head and the work table.

It may be recalled that on the Elb machines the table traverses in the longitudinal direction only, and cross feed is applied to the wheel-head column, which moves on guideways at the rear of the bed. The wheel spindle runs in plain, paraffin-lubricated, bearings, and is usually driven direct, at speeds of 1,400 and 2,800 r.p.m., by a 2-h.p. pole changing motor. Built-in reduction gearing can be brought into use to provide the necessary slow spindle speed for wheel crushing. If required, a Ward-Leonard drive system can be supplied, to give steplessly-variable spindle speeds.

The Schmaltz rotary table surface grinder, which was shown in operation, is available in four sizes with tables of 15¾, 19⅝, 23⅝, and 27½ in. diameter. Workpieces up to 4¾ in. thick can be ground on the two smaller machines, and up to 6⅝ in. thick on the larger sizes, and the table speeds can be varied steplessly from 22 to 28 r.p.m., and from 12 to 60 r.p.m. Vertical feed can be applied to the table either by hand or automatically. The ram-type wheel-head is traversed on guideways at the top of the column, at a maximum speed of 10 ft. per min., and can be tilted through angles up to 2 deg., in each direction.

New Mond Nickel Films

In the year 1932, news was first received from Japan of the discovery of a new series of permanent magnet alloys in which the principal elements were nickel, iron, and aluminium. These materials were reported to possess properties far in advance of those obtainable with the cobalt steels, which, up to that date, were the best permanent-magnet materials available. Subsequent development work was carried out in various countries, including Britain and the U.S.A., and further improvements, resulting from the inclusion of cobalt, led to the introduction of the class of alloys generally known as Alnico. It was then discovered, in 1938, that still better properties could be obtained by allowing the material to cool from a high temperature in a magnetic field. This discovery led to the production of Alcomax and Hycomax alloys, and further advances have since resulted from the use of niobium, and the adoption of casting techniques whereby columnar crystals, orientated in the preferred axis of magnetization, are obtained.

The magnetic properties of the nickel-iron alloys, and particularly stability and strength, are the subject of a new colour film, with a running time of 21 min., which has been produced by the Mond Nickel Co., Ltd., Thames House, Millbank, London, S.W.1, and is entitled "Nickel Alloy Permanent Magnets."

First, the well-known properties of magnets are reviewed, and the striking increase in the power of the newer magnet materials is explained. The high stability of magnets containing nickel is demonstrated by tests in which an Alcomax magnet is subjected to extreme conditions of heat, cold, and vibration. Subsequent sections are concerned with the manufacture of magnets; some industrial applications, for example, in chucks for lathes and grinders; and the use of magnets in an automatic train control system, in magnetron oscillators for aircraft radar equipment, and in the rotors of electric speedometers.

"Spheroidal Graphite Cast Iron" is the title of another recently-issued Mond Nickel colour film. This film represents a revision of the first on the subject, which was introduced by the company some five years ago, and it runs for 28 min.

Opening with a brief reference to the advantages and limitations of the ordinary flake graphite and malleable cast irons, the film then shows how, with the transformation of the graphite from flake to spheroidal form, iron can be caused to assume some of the properties of steel yet still retain its castability. The ductility of the material in the annealed state is demonstrated by tests, and attention is also drawn to the good machining qualities, and the extent of the field of applications.

Both films are obtainable free of charge, on loan, in the 16-mm. size, on application to the publicity department of the Mond Nickel Co., Ltd.

STEEL PRODUCTION in the U.S.A. during the first seven months of this year averaged 5,628,000 tons per month, as compared with 8,387,000 tons for the full year 1957. For Western Germany the corresponding figures were 1,933,000 (eight-month average) and 2,010,000, and for the U.K., 1,663,000 (eight months) and 1,808,000 tons.

News of the Industry

Glasgow and District

HUGH SMITH & CO. (POSSIL), LTD., Glasgow, are making good progress with their building extension programme, and we noted that the steel framework has now been erected for the third and final stage. Orders are in hand for a variety of work, including plate bending rolls, plate edge planing machines, hydraulic beam bending machines, combined flanging presses and bending rolls, gap-type flanging presses and cold frame bending machines, in a wide range of sizes, for both the home and Continental markets. Outstanding among equipment recently ordered are a 45-ft. by 2-in. plate edge planer equipped with rotary shears for ⅝ in. thick plates, for the Rotterdam Dry Dock Co., Ltd., Holland; two 2,000-ton combined flanging presses and bending rolls for plates up to 42 ft. 6 in. long, one for Swan, Hunter & Wigham Richardson, Ltd., Wallsend, and the other for a Danish shipyard; and a cold frame bending machine for a Sunderland shipyard, for dealing with welded-type ships' frames.

A. P. NEWALL & CO., LTD., Glasgow, are engaged in the production of their various types of high-stress- and high-temperature-resisting steel bolts, screws, studs and nuts, also high-tensile steel structural bolts. It is claimed that uniform loading can be achieved in structural engineering work by the use of Newall Torshear structural bolts in conjunction with a specially-designed pneumatic spanner, made by North Bar Tool Co., Ltd., Banbury, Oxon.

JOHN S. YOUNG & CO., LTD., Giffnock, Glasgow, report a reasonably good demand for the various machine tools and cutting tools, including Stag Major tools, for which they are selling agents. This firm was the main contractor for the equipment recently required for the Reid-Kerr trade college in Paisley, and is the sole agent for the new Genelin hydraulically-driven bending rolls to which we hope to make further reference shortly. The new fabrication shop, where parts stillages, industrial trucks, and mechanical handling equipment are being produced, is now in full use, and extensions are contemplated.

W. CROCKATT & SONS, LTD., Glasgow, are doing a steady business in all types of gear-cutting, and the latest additions to plant in the department are a Sunderland No. 16 spur and spiral gear planing machine with double-helical attachment and a Zuffenhausen MS12 worm milling machine. Other activities at these works include the production of electric salinometers, valve reseaters, feed water filters, and floor polishing equipment.

CROW, HAMILTON & CO., LTD., Glasgow, are mainly employed on orders for bar and tube reeling and straightening machines of various capacities, and on special-purpose machinery. Locomotive boiler-tube de-scaling machines are also produced at these works, some of which have been supplied to India.

DEMPSTER, MOORE & CO., LTD., Bonnybridge, are steadily occupied with the production of standard machine tools mainly required for installation on board ship. These machines include lathes from 7½- to 9½-in. centres, on beds up to 12 ft. long, vertical drilling machines of 1½ in. diameter capacity, and 12- and 14-in. double-wheel tool grinding machines. We noted a special horizontal roll drilling machine in hand, equipped with two saddles, to which we hope to make further reference at a later date.

THE REID GEAR CO., LTD., Linwood, Paisley, have various sizes of spur, bevel, worm and double-helical gears in progress, some of which are required for colliery, haulage and conveyor work. Among other destinations for the firm's gearing may be mentioned the Scottish hydro-electric schemes, turbine and pumping plants, steelworks, and machine tool works. In addition, activities include the production of both standard and special gearboxes. We may note that some capacity is available in the gear grinding department.

THOMAS WHITE & SONS, LTD., Paisley, have a variety of both standard and special woodworking machinery in course of production for home and overseas customers. Steady employment is maintained in the department producing jigs, fixtures, press tools and gauges, and special multi-point gauging equipment. Other work in hand includes shear blade surface grinding machines, which were formerly built by Luke & Spencer, Ltd., Broadheath, Manchester, and were described in MACHINERY, 93/383—13/8/58.

C. & G. OLDFIELD, LTD., 15 Abercorn Street, Paisley, are experiencing a steady demand for the products of the various machine tool makers they represent. A good selection of new and used

machine tools and presses is available for inspection on the premises, which formerly housed an electricity sub-power station. The overhead electric travelling cranes have been retained to facilitate handling the machinery.

ABBOT ENGINEERING CO., LTD., Paisley, report that orders for spur, bevel, worm and double-helical gear-cutting are maintained at about the recent level. A good proportion of the firm's output is destined for local crane-builders and other industrial undertakings.

A. & W. SMITH & CO., LTD., Glasgow, sugar factory and refinery engineers, whose milling machinery has been supplied to all parts of the world, are at present extending their works and augmenting plant, and new office accommodation has recently been occupied. The firm's subsidiaries, R. G. Ross & Son, Ltd., and Foundry Plant Machinery, Ltd., are occupied, respectively, with the production of electro-pneumatic, steam and compressed air forging hammers of various capacities, and sand-slinging equipment for foundry use.

B. ARTHUR HEMS, LTD., Glasgow, inform us that business in machine tools and small tools during recent weeks has shown signs of expansion. Extensive stocks of a wide range of small tools are maintained, to ensure prompt service.

R. & J. DICK, LTD., Glasgow, are experiencing a steady flow of orders, on both home and export account, for flat and V-type belts. Among the regular lines we may note Balata belts, Dixylon Suplex plastics transmission belts, Dickrope Plus V-belts, and link V-belting.

H. B.

Utrasonic Welding

(Continued from page 919)

sheet as employed in the fabrication of strainers. The material has a pattern of 0·006-in. diameter holes, and in preparation for welding, the holes in two pieces are lined up by means of fine wires. In the weld area, a good bond is obtained in the material between the holes, and the latter remain unobstructed.

An aluminium heat exchanger incorporates a flat, 0·072-in. thick sheet, and a corrugated sheet of 0·006-in. thick material. The two are joined by continuous ultrasonic welds at the bottoms of the corrugations, and it is stated that, in these conditions, welding speeds up to 25 ft. per min. are possible. Ultrasonic welding has also proved effective for the fabrication of "waffle-type" sandwich structures, because it enables the "waffle" filler to be bonded to inner and outer skins with weld spots of fairly large area.

It will be evident, therefore, that welding by high frequency vibration already represents a useful addition to the available joining processes, and it is likely to find increasing application as the equipment is further developed.

Industrial Notes

DEMONSTRATIONS OF LAPPING will be given at an exhibition to be held at the Hounslow plant, Lawrence Estate, Green Lane, Hounslow, of Payne Products International, Ltd., from November 10 to 21. The operations will be carried out on Lapmaster machines, and prospective visitors are invited to send specimen components to the company, in advance, so that they may see them lapped during the course of the exhibition. Various accessories are also to be shown, such as Lapmaster monochromatic lights for checking flatness; optical flats, from 1 to 12 in. diameter; polishing plates; hand lapping plates and pastes; and polishing stands.

Obituary

MR. C. A. PRINCE, production director of British Vapour Blast, Ltd., Rose Hill, Coalbrookdale, Nr. Ironbridge, Salop., and of Intermetric Processes, Ltd., died suddenly on October 12.

Machine Tool Demonstration

A demonstration of the latest machine tools produced by Churchill-Redman, Ltd., was recently staged at their West End Works, Halifax. Two of the new P.5 automatic multi-tool and profile turning lathes (see MACHINERY, 92/5/70—7/3/58) were shown, machining a bevel pinion shaft in two operations, the first of which was completed in a cycle time of 96 sec., and the second in 45 sec. We hope to publish more details of these turning operations in the near future.

Other machines demonstrated included a Fay 8-in. swing multi-tool lathe with hydraulic profiling equipment; a 12- by 20-in. semi-automatic hydraulic profiling lathe; centre lathes of 15-, 22-, and 28-in. swing, the latter provided with hydraulic copying equipment; a 28-in. swing surfacing and boring lathe with hexagon turret mounted on the saddle; and 18- and 24-in. stroke heavy-duty shaping machines, the former equipped with a swivelling work table.

Examples of power-operated chucks and hydraulic units were also on view.

Machine Tool Share Market

Stock markets were firm and generally cheerful during the period under review, and conditions in nearly all sections were very active.

British Funds were well supported and other high-grade fixed interest stocks also received attention at steadily improving levels.

The commercial and industrial sections became buoyant, and finished on a strong note, with higher prices over a wide range of securities, as a result of sustained investment and speculative demand.

Among machine tool issues, Asquith Machine Tool advanced 3d. to 21s. 6d.; British Oxygen, 3s. to 43s.; Chas. Churchill, 1½d. to 5s. 1½d; John Harper, 1½d. to 15s. 9d.; Churchill Machine Tool, 9d. to 18s. 1½d.; Geo. Cohen, 6d. to 11s.; Sheffield Twist Drill, 6d. to 12s. 9d.; Alfred Herbert, 7½d. to 36s. 3d.; Kayser Ellison, 1s. 6d. to 46s. 6d.; John Shaw & Sons (Wolverhampton), 4½d. to 14s. 1½d.; and Thos. W. Ward, 1s. to 85s. 6d.

WADKIN, LTD. Interim dividend 5 per cent (same).

THOS. W. WARD, LTD. Final dividend 10 per cent, plus a bonus of 5 per cent, making, with the interim, a total distribution of 20 per cent.

COMPANY		Denom.	Middle Price
Abwood Machine Tools, Ltd.	Ord.	1/-	9d.
Armstrongs, Stevens & Son, Ltd.	Ord.	5/-	8/3
Allen (Edgar) & Co., Ltd.	Ord.	£1	35/6
" "	5% Prf.	£1	15/3*
Arnott & Harrison, Ltd.	Ord.	4/-	15/6
Asquith Machine Tools Corp., Ltd.	Ord.	5/-	21/6
" " "	6% Cum. Prf.	£1	18/6
Birmingham Small Arms Co., Ltd.	Ord.	£1	31/9
" " "	5% Cum. "A" Prf.	£1	15/6
" " "	6% Cum. "B" Prf.	£1	18/-
" " "	4% 1st Mort. Deb.	Stk.	88½
British Oxygen Co., Ltd.	Ord.	£1	43/-
" " "	6½% Cum. Prf.	£1	22/-
Brooke Tool Manufacturing Co., Ltd.	Ord.	5/-	3/10½
Broom & Wade, Ltd.	Ord.	5/-	13/3
" "	6% Cum. Prf.	£1	17/9
Brown (David) Corporation Ltd.	5½% Cum. Prf.	£1	15/6
Buck & Hickman, Ltd.	6% Cum. Prf.	£1	17/9
Butler Machine Tools Co., Ltd.	Ord.	5/-	8/-
" " "	5% Cum. Prf.	£1	13/9
C.V.A. Jigs, Moulds & Tools, Ltd.	5½% Red. Cum. Prf.	£1	11/3
Churchill (Charles) & Co., Ltd.	Ord.	2/-	5/1½
" " "	6% Cum. Prf.	£1	26/4½
Churchill Machine Tool Co., Ltd.	Ord.	5/-	18/1½
" " "	6% Cum. Prf.	£1	18/3
Clarkson (Engrs.), Ltd.	Ord.	5/-	15/-xd
Cohen (George), Son & Co., Ltd.	Ord.	5/-	11/-
" " "	4½% Cum. Prf.	£1	14/6
Coventry Gauge & Tool Co., Ltd.	Ord.	10/-	16/3
" " "	5% Cum. Red. Prf.	£1	16/3
Coventry Machine Tool Works, Ltd.	Ord.	4/-	8/6
Craven Bros. (Manchester), Ltd.	Ord.	5/-	8/4½
Elliott (B.) & Co., Ltd.	Ord.	1/-	3/3xd
" "	4½% Red. Cum. Prf.	£1	13/9
Expert Tool & Case Hardening Co., Ltd.	Ord.	2/-	1/3
Firth Brown Tools, Ltd.	4% Cum. Prf.	£1	12/6
Greenwood & Batley, Ltd.	Ord.	£1	50/7½

COMPANY		Denom.	Middle Price
Harper (John) & Co., Ltd.	Ord.	5/-	15/9
" "	4½% Red. Cum. Prf.	£1	12/10½
Herbert (Alfred), Ltd.	Ord.	£1	36/3
Holroyd (John) & Co., Ltd.	"A" Ord.	5/-	12/9
" "	"B" Ord.	5/-	12/3
Jones (A. A.) & Shipman, Ltd.	Ord.	5/-	22/-
" " "	7% Cum. Prf.	5/-	5/-
Kayser, Ellison & Co., Ltd.	Ord.	£1	46/6
" " "	6% Cum. Prf.	£1	18/3
Kendall & Gent, Ltd.	Ord.	5/-	7/-
Kerry's (Gt. Britain), Ltd.	Ord.	5/-	6/3
Kitchen & Wade, Ltd.	Ord.	4/-	8/3
Martin Bros. (Machinery), Ltd.	Ord.	2/-	2/4½
Massey, B. & S., Ltd.	Ord.	5/-	9/-
Modern Engineering Machine Tools Ltd.	Ord.	5/-	10/7½
Newall Engineering Co., Ltd.	Ord.	2/-	4/9
Newman Industries, Ltd.	Ord.	2/-	2/3
" "	6% Prf. Ord.	5/-	5/6
Noble & Lund, Ltd.	Ord.	2/-	3/9
Osborn (Samuel) & Co., Ltd.	Ord.	5/-	21/-
" " "	5½% Cum. Prf.	£1	25/9
Pratt (F.) & Co., Ltd.	Ord.	5/-	22/6
Scottish Machine Tool Corporation, Ltd.	Ord.	4/-	5/6
Shardlow (Ambrose) & Co., Ltd.	Ord.	£1	43/6
Shaw (John) & Sons, Wolverhampton, Ltd.	Ord.	5/-	14/1½
Sheffield Twist Drill & Steel Co., Ltd.	Ord.	4/-	12/9
" " " "	5% Cum. Prf.	£1	15/-
Stedall & Co., Ltd.	Ord.	5/-	7/6xd
Sykes (W. E.) Ltd.	"B" non-voting Ord.	10/-	22/-
Tap & Die Corporation, Ltd.	Ord.	5/-	8/-
" " "	4½% Deb. 1961-1977	Stk.	82/-
Wadkin, Ltd.	Ord.	10/-	18/9
Ward (Thos.) W.), Ltd.	Ord.	£1	85/6
" "	5% Cum. 1st Prf.	£1	16/-
" "	5% Cum. 2nd Prf.	£1	24/-
Willson Lathes, Ltd.	Ord.	1/-	2/4½

The Middle Prices given in the list are in several cases nominal prices only and not actual dealing prices. Every effort is made to ensure accuracy, but no liability can be accepted for any error. * Sheffield price. † Birmingham price.

PRICES OF MATERIALS

All prices per ton except where otherwise stated.

Pig-Iron

Foundry and Forge No. 3, Class 2

Middlesbrough zone	£21 6 0
Birmingham	£20 18 3

Phos. 0·1 to 0·75%

Birmingham	£23 17 0

Scottish Foundry

Grangemouth	£25 3 6

Hæmatite

English No. 1

N.E. and N.W. Coast	£25 6 6
Scotland	£25 13 0
Sheffield	£26 15 0
Birmingham	£27 4 0
Welsh	£25 6 6

Steel Products

Medium plates	£45 11 6
Mild steel plates, ordinary*	£42 2 0
Boiler plates*	£44 12 0
†Flat bars 5 in. wide and under †Round bars under 3 in.	£40 0 6
Billets, rolling quality, soft U.T.	£32 15 6

Phosphor Bronze

Ingots (2B8) (A.I.D.) d/d	£270 0 0

Copper

Cash (mean)	£241 15 0
Cold rolled and hot rolled sheets 4 ft. by 2 ft. by 10 SWG	£306 5s. 0—£306 10 0
Rods 5/16 in. to ¾ in. diam.	£324 5 0
Tubes, 1½ in. bore by 10 SWG, ton lots, per lb.	3s. 1½d.
Wire rod, black, hot-rolled (¼-5/16 in.) English	£257 17 6

Zinc

Refined, minimum 98 per cent. purity, current month (mean)	£70 17 6

Brass

Tubes, solid drawn, per lb.	1s. 10½d.
Strip 63/37, 6 in. by 10 SWG coils, ton lots	£254 0 0—£256 15 0
Rods, ¼-3in. diam. (59 per cent copper)	2s. 0½d.

Yellow Metal

Condenser plates, per ton	£189 0 0
Rods, per lb.	2s. 1½d.

Aluminium

Ingots min. 99·5 per cent Canadian d/d	£180 0 0

Lead

Refined, minimum 99·97 per cent purity, current month (mean)	£74 15 0

Tinplates

‡U.K. Home trade:	
Handmill f.o.t. makers' works	£3 11 8¼
Cold reduced, f.o.t. makers' works	£3 7 4¼
U.K. Export:	
Hot rolled basis, f.o.t. works' port	72s. 6d.—75s. 0d.
Cold reduced basis, f.o.t. works' port	75s. 0d.

Gunmetal

Ingots, 85.5.5.5. ex works	£191 0 0

* N.E. Coast, N. Joint Area, Central Scottish Zone.

† U.T. soft basic.

‡ Official maximum price, after allowing for adjustments for increase in price of tin.

MAKERS' PRICES

Hexagon Steel Bars[1]

Sizes in inches from 1 in. up to 2·21 and 2·41 a/f, ex works 2 ton basis	£42 17 0
Free cutting black	£47 6 6

Reeled Steel Bars[1]

Single-reeled 1½ in. upwards, f.o.t. works (+ usual extra for sizes)	£43 9 6
Free cutting	£47 19 0

Precision-ground Mild Steel[2]

1-in. dia. + 0·00025-in. 4-ton lots, per cwt.	121s. 6d.

Bright Ground Stainless Steel Bars[3]

EN56AM (martensitic, free cutting)	£285
EN58AM (austenitic, free cutting)	£353

High-Speed Steel

Black random length bar. All prices basic, per lb., subject to extras.

Molybdenum "66"	5s. 10d.
Molybdenum "46"	5s. 8d.
14 per cent tungsten	5s. 6d.
16 pe cent tungsten	5s. 10d.
18 per cent tungsten	6s. 0d.
22 per cent tungsten	7s. 0d.
5 per cent cobalt	9s. 1d.
4·75/5·25 molybdenum + 6·0/6·75 tungsten + 1·75/2·05 vanadium per cent (5-6-2)	6s. 0d.

Precision-ground, High-speed Free-turning Brass Rod[2]

⅝-in. dia. ± 0·00025-in. 2-ton lots, per lb.	2s. 5⅝d.

Grey Iron Rod

Die Cast[4]

in random lengths 18 in. to 26 in. rough machined 1/16-in. above listed size. Extra for definite lengths. Discounts for orders over £150.

	Per cwt. net. Mark I	Mark III
½ or ⅞ in.	245s. 4d.	318s. 10d.
1 or 1⅛ in.	196s. 4d.	251s. 10d.
1¼ to 1½ in.	137s. 10d.	171s. 2d.
1⅝ to 2 in.	106s. 2d.	125s. 11d.
2¼ to 3½ in.	91s. 6d.	106s. 4d.
3⅝ to 12 in.	86s. 6d.	99s. 2d.

Continuous Cast

10-ft. lengths, centreless machined 1 to 3-in. dia. + 0·010 to 0·020 in., prices as quoted for die cast bar[4]

6-ft. lengths	½ or ⅞ in.	245s. 4d.
centreless ground	1 or 1⅛ in.	196s. 4d.
+ 0·010 in. Extra		
for hardenable	1¼ to 1½ in.	137s. 10d.
alloy iron[5]	1⅝ to 2 in.	106s. 2d.
Per cwt. net	2¼ to 3½ in.	91s. 6d.

Stellite[6]

Welding Rods plain

¼ in. dia. per lb.	30s. 0d.

Toolbits

¼ in. sq. × 4 in., each	22s. 3d.

1 Colvilles, Ltd., Glasgow, and 17 Grosvenor Street, London, W.1. 2 Pratt, Levick & Co., Ltd., Chester, 3 Spartan Steel & Alloys, Ltd., St. Stephens Street, Birmingham, 6. 4 Sheepbridge Alloy Castings, Ltd., Sutton-in-Ashfield. 5 "Flocast," Harold Andrews Sheepbridge, Ltd., Halesowen, 6 Deloro Stellite, Ltd., Highlands Road, Shirley, Solihull.

BASIC PRICES FROM LONDON STOCK[6]

Free Cutting Steel

Bright cold drawn: (Usaspead) over 1½ to 2 in.	£59 17 6
Lead bearing (Usaled)	£64 4 0
Precision ground, 1¾ in.	£81 13 6

Bright Drawn

M.S. bars (M.M.C.) over 1½ in. to 2 in.	£55 3 6
Square edge flats (Usaflat)	£72 0 0
M.S. angles (Usaspead)	£99 10 0
Casehardening (EN) (Usacase) over 1½ in. to 2 in.	£63 9 6
M.S. bars (EN3B) (Usamild) over 1½ to 2 in.	£57 3 6
Carbon manganese semi-freecutting case hardening (EN202) (Usaspead 202) over 1½ to 2 in.	£72 19 0
35/45 ton tensile (EN6) (Usen) over 1 to 1½ in.	£64 17 6
0·4 Carbon Normalised (Usaspead "40") over 1½ in. to 2 in.	£66 19 6
Carbon manganese steel to Specification EN.16.T (Usaspead 5565), per ton	£127 11 3

Ground Flat Stock

18-, 24-, and 36-in. lengths (Usaspead). List prices less 5 per cent

Oil Hardening Cast Steel

Non-shrink (Usaspead N.S.O.H.) ⅜ in. to 2¾ in., per lb.	1s. 11d.
Non-distorting heavy duty (Usaspead H.C.H.C.) ⅜-in. to 2¾-in., per lb.	4s. 2d.

Silver Steel

(0·194-in. to 1½-in.) Genuine Stubs quality, per lb.	4s. 6d. less 27½%
M.M.C. quality, per lb.	2s. 5d. + 6¼%
Boxes of 16 assorted sizes 1/16-in. to ½-in. dia.	7s. 6d.

Stainless Steel

K.E. 40.AM (Freecutting), per lb.	3s. 3½d.

Glacier Machined Bronze Bars

Phosphor bronze (2B8) Lead bronze	Prices on application

High-speed Steel

18 per cent tungsten. Prices on application.

Toolholder bits: Usaspead "Super" ,, "Supreme" ,, Cobalt 10	List price

Shimstock

Steel assorted, per tin	3s. 6d
Brass ,, ,,	7s. 3d.

6 Macready's Metal Co., Ltd., Pentonville Road, N.1. Subject to confirmation by London Office. Delivered free by van in London area.

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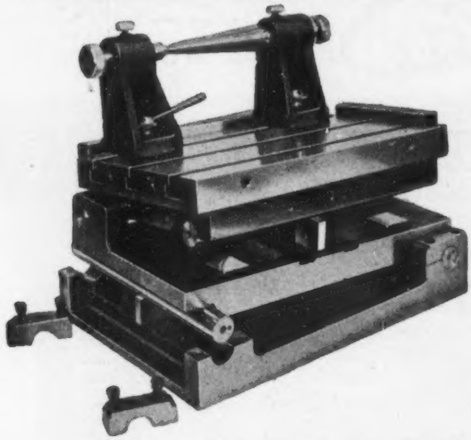
NEW UNIVERSAL TYPE: *MADE TO HINGE FROM EITHER END OF BASE PLATE TO ENABLE ALL COMPOUND ANGLES TO BE OBTAINED*



◀TYPE E.W.U/L. Face 11in. × 7in. £185 complete with 6in. centres.

SIZES: TYPE E.W.U/L.
Face (T Slotted) .... 11in. × 7in.
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Height at rest .... 5in.
10in. and 5in. Roller Centres.
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Table w.s. 63" x 15"
Spindle speeds (20) 30—1;200 rpm.
Power traverses 51½" x 14½" x 21⅞"
Table feeds (16) .281"—22" per min.
H.P. 17
Weight 7040 lbs.

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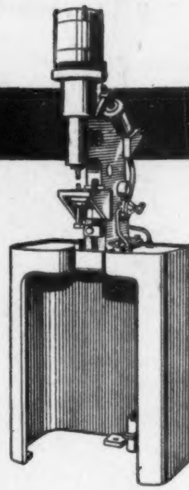

Illustrated :
RS3 V.M.D. A.E. $\frac{3}{16}$in. cap. air operated machine on cabinet base.

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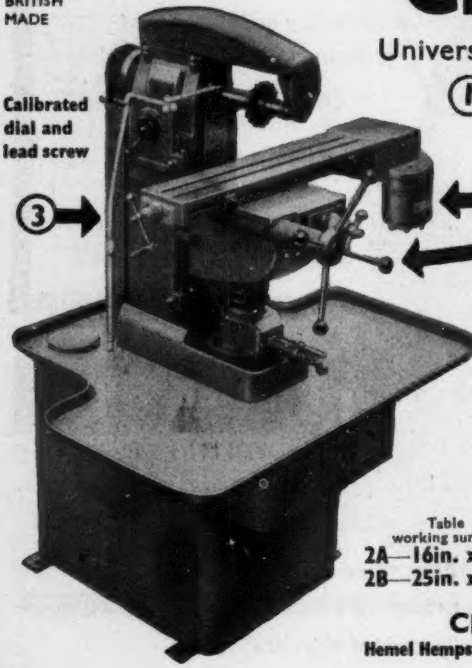
(1) (2) (3) Possibilities of table movement

ALL GEARED 6 spindle speeds



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With big advantage of fast table approach by Capstan Handle followed by automatic feed on cut and fast return by Capstan Handle.

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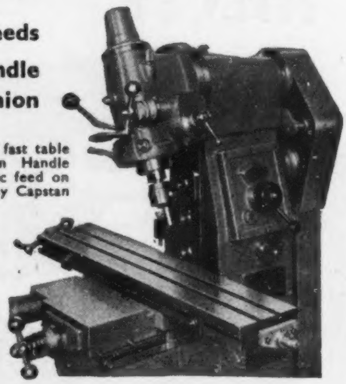
Rotary table

	Table working surface	Long Traverse
2A	16in. x $4\frac{1}{2}$in.	8in.
2B	25in. x 5in.	13in.



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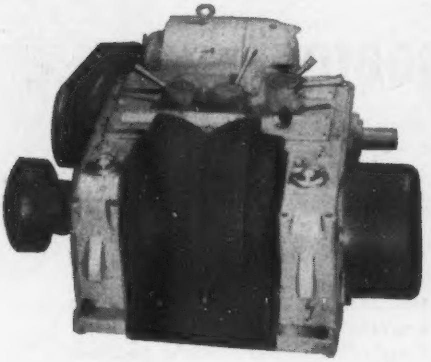

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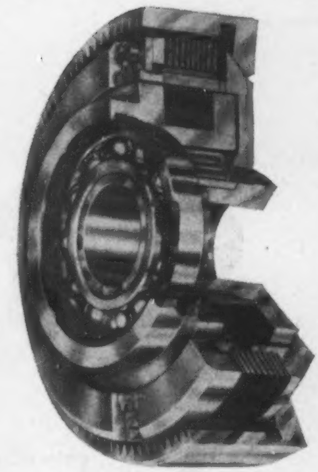

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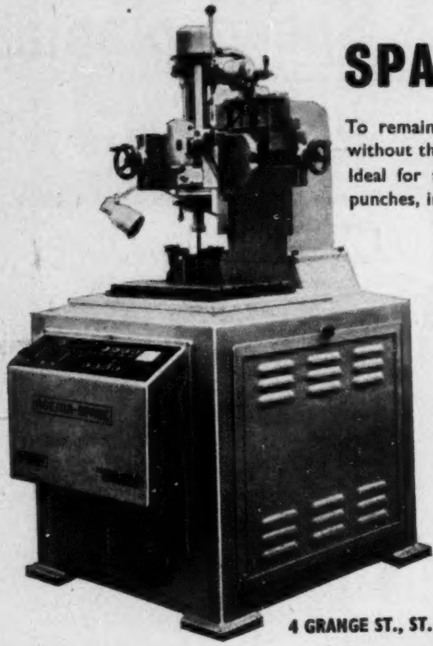

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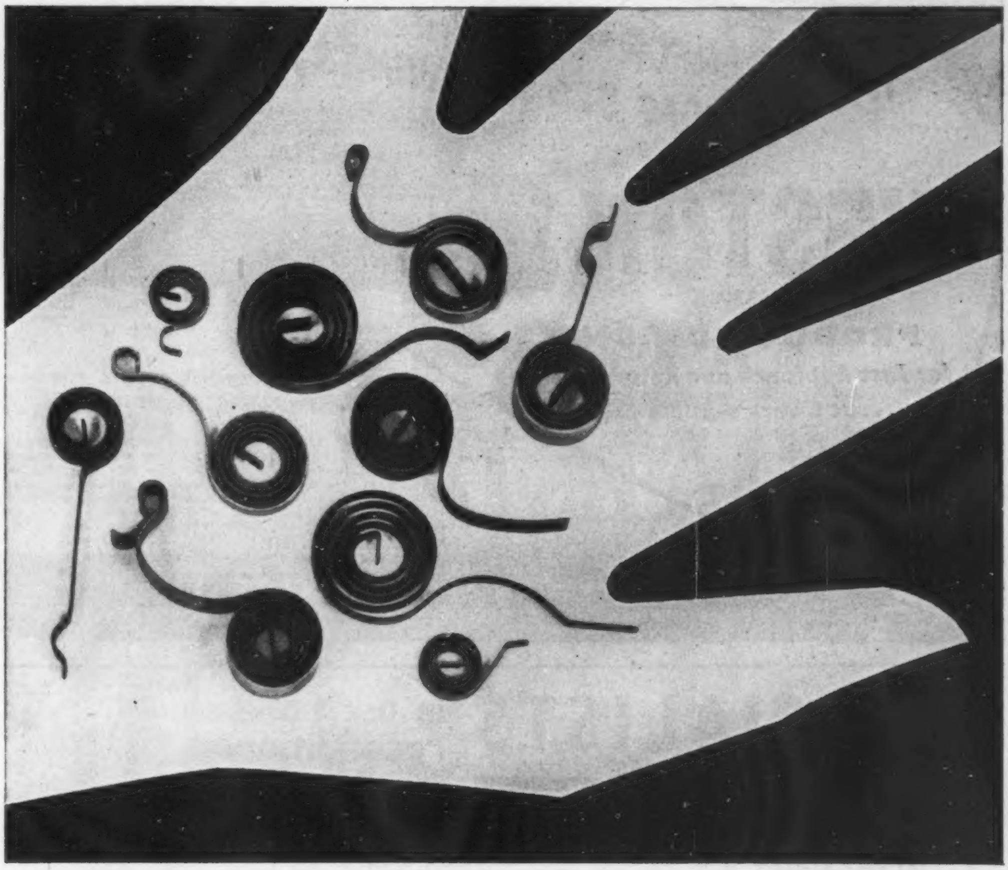

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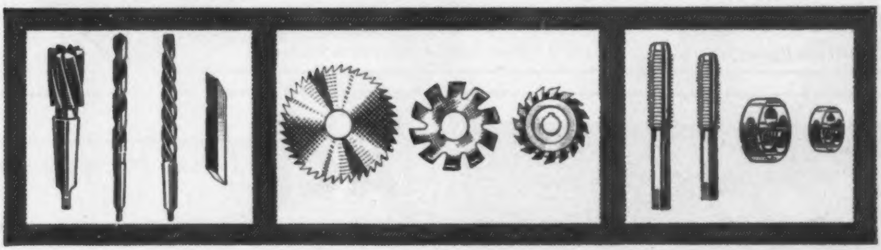

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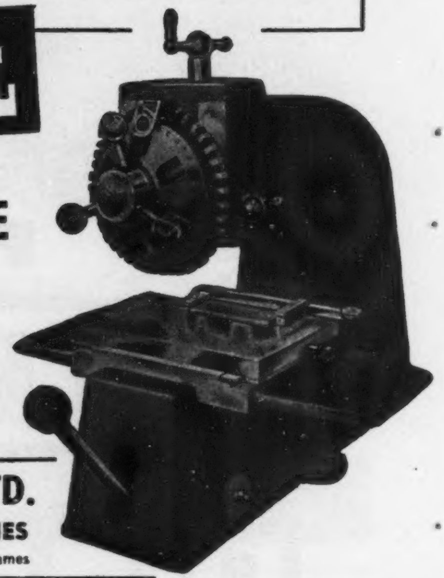

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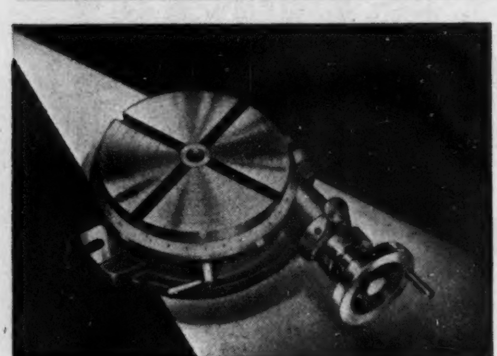

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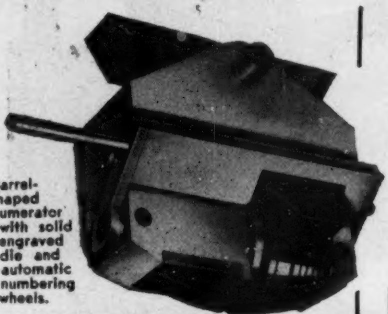
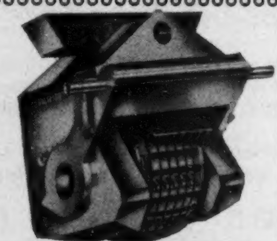


Barrel-shaped numerator with solid engraved die and automatic numbering wheels.



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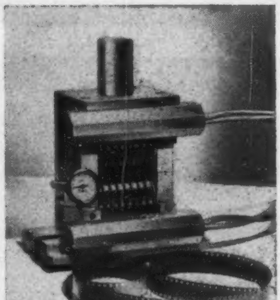

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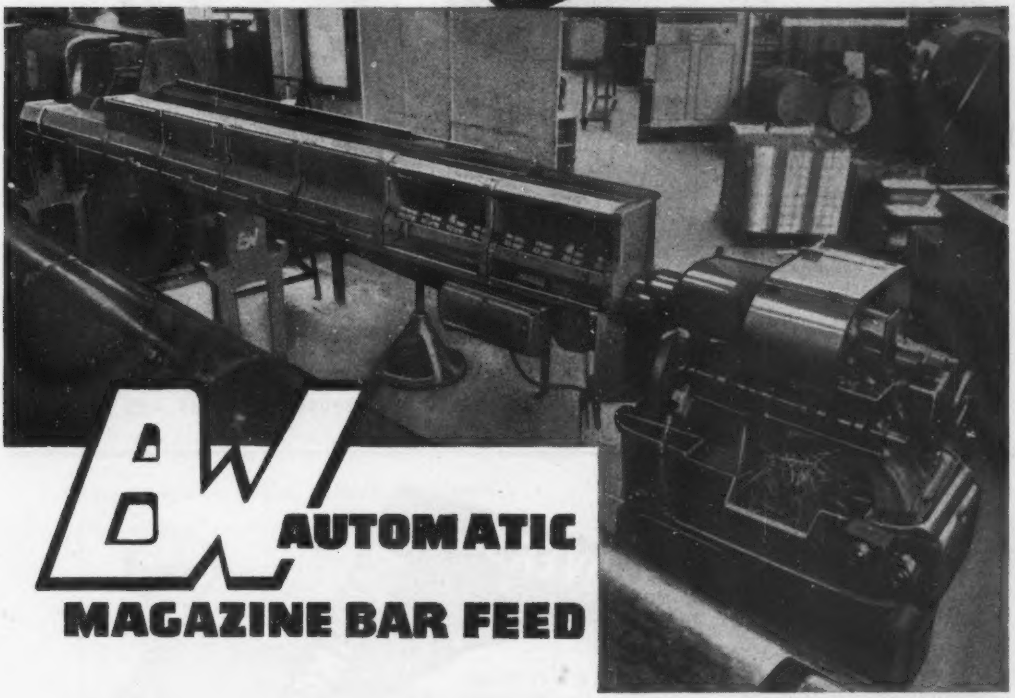

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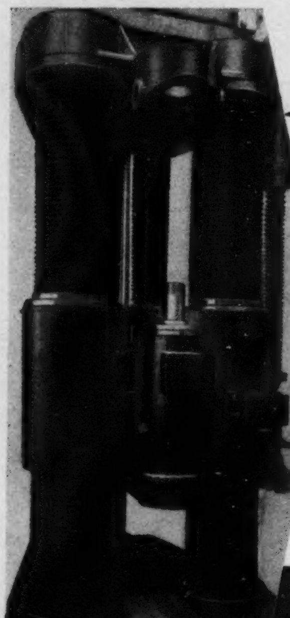

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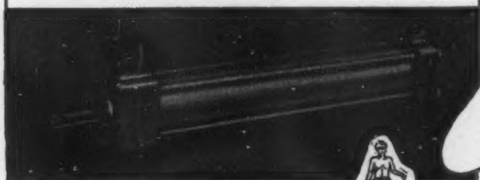

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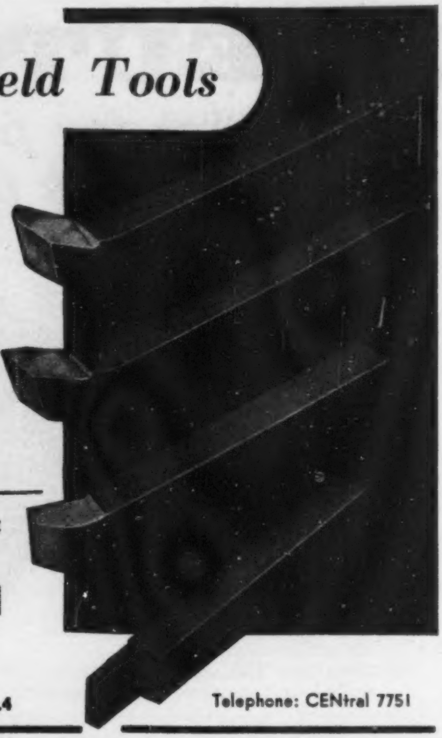

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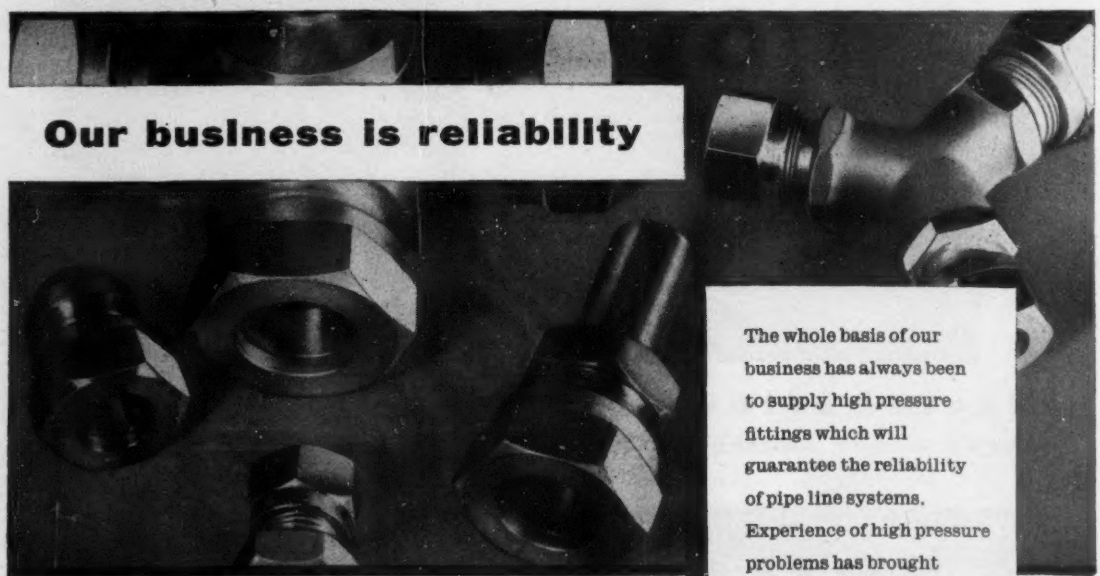

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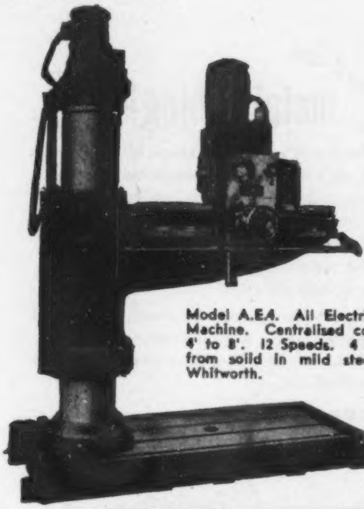
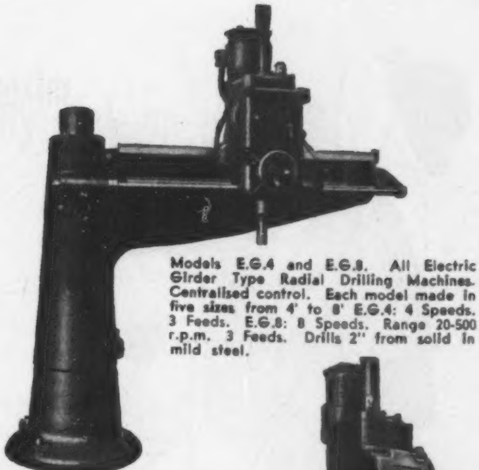


Model A.E.4. All Electric Radial Drilling Machine. Centralised control. Six sizes, 4' to 8'. 12 Speeds. 4 Feeds. Drills 2¼" from solid in mild steel and taps 1½" Whitworth.



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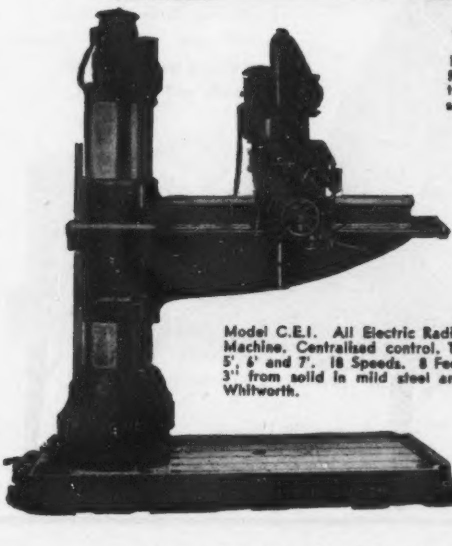

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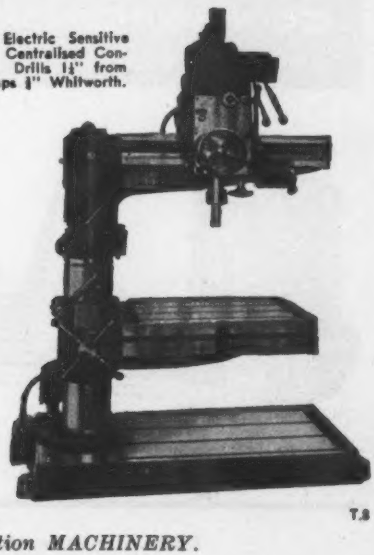

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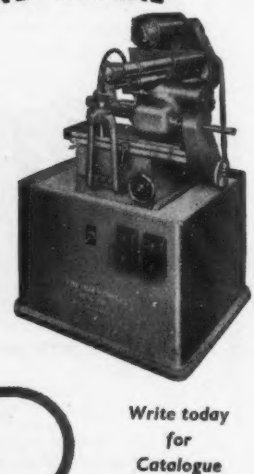

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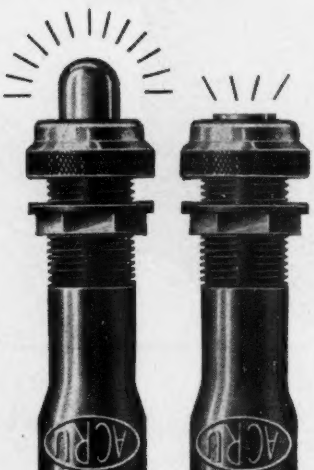

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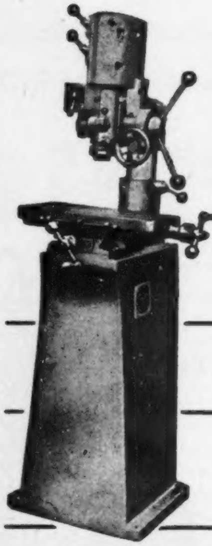

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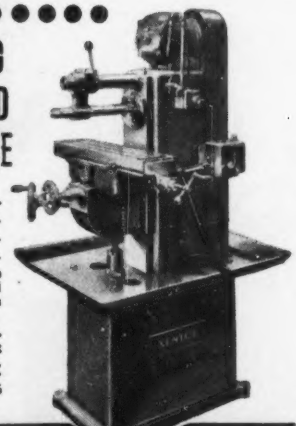

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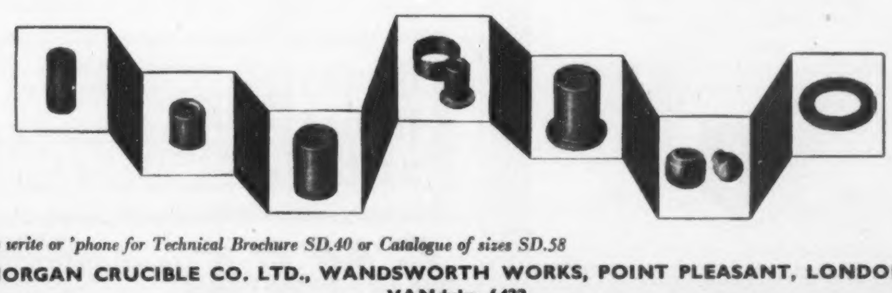

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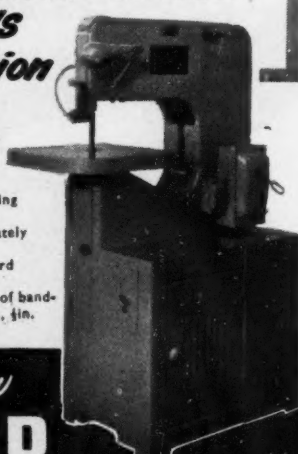

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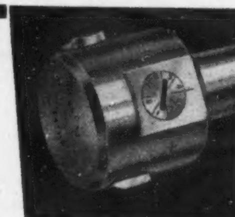

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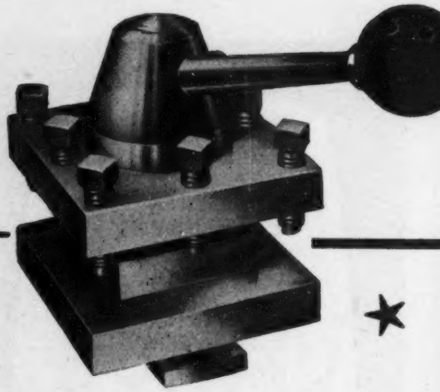

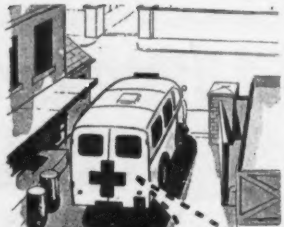

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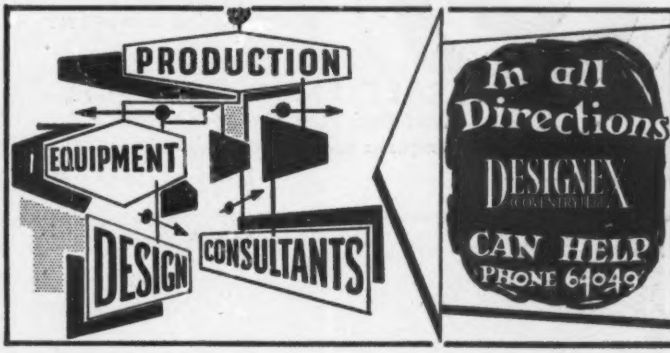

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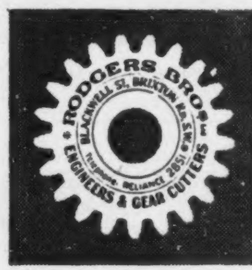

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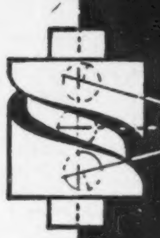

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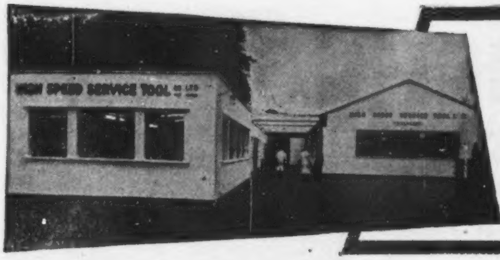

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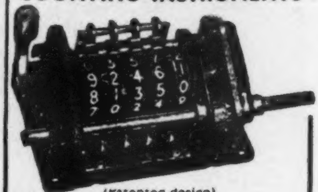

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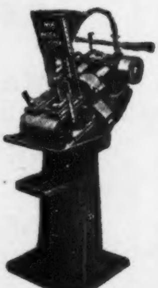

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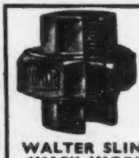

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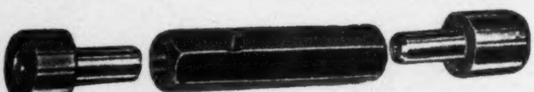

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LIBBY 4R 2in. Capstan Lathe. Bar feed.
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HERBERT No. 7 Turret Lathe.
FOSTER No. 2B Turret Lathe.

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Cincinnati 1/18 Production Miller A.G.H. Table 41in. × 10in. Mot.—WILCOX & CO., Barr Street, Birmingham 19. Northern 1234/5.

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No. 3U "Adcock & Shipley" motorised all-geared Universal Milling Machine. Table 50in. by 12in., has longl. travel of 30in. Spindle speeds 20-1,400 r.p.m. Auto feed ½in.-50in. per min. all movements. Rapid traverse by separate motor. Good equipment. Post war machine.—LEE & HUNT, LTD., Crocus Street, Nottingham. Tel.: 84246.

Cincinnati 2 M.H. Plain Hor. Milling machine in excellent condition. Cheap to clear.—BOX Z591, MACHINERY, Clifton House, Euston Road, N.W.1.

Myford (New) MG. 12 5in. × 12in. Cylindrical Grinding Machine, with swivel workhead, motorised 400/3/50.—SOUTHERN ENGINEERING & MACHINERY CO., Connaught Buildings, Tanners Brook, Millbrook, Southampton. Tel.: Southampton 73101.

Index Model ON8 Single-spindle high speed, Automatic Lathe, 400/3/50.—HICKS MACHINERY, LTD., 26, Addison Place, London, W.11. Tel.: PARk 2333.

Samsonwerke Surface Grinder, Table 24in. × 8in., mag. chuck, 400/3/50.—C. DUGARD, LTD., Denmark Villas, Hove 32471

Horizontal Boring. Dickinson 3in. Travelling Spindle Horizontal Borer No. 5 M.T., 45in. × 28in. main table, 10 h.p. motor for 400/3/50 cycles A.C. supply, £595.—TATE MACHINE TOOL CO., LTD., 6, North End Parade (opp. Olympia), London, W.14. Telephone: Fulham 6563 (3 lines).

Classified Advertisements (*PLANT FOR SALE, contd.*)

Classified Advertisements (*PLANT FOR SALE, contd.*)

RING BELLS *for machine tools*
LEEDS 63-7398

Jones & Shipman 1051EF precision universal production grinder, 10in. × 27in. B. centres complete with all equipment including clarifying unit. 1957 machine. As new. No reasonable offer refused. —DORAN ENGINEERING CO., LTD., March End, Wednesfield, Staffs. Telephone: Wolverhampton 31050.

URQUHART

NEW MACHINES EX STOCK FOR IMMEDIATE DELIVERY

COLCHESTER Lathes, Mascot, 8in. by 60in.
TRIUMPH 7½in. by 48in.
STUDENT 6in. by 24in.
CHIPMASTER 5in. by 24in
"ACE" Bench Lathe, 4½in. centres by 23in., between. Norton feed box and on cabinet stand. 415/3/50.
ROBLING Lathe, Model 600/2, 5½in. centres by 24in. between, 1,920 r.p.m. accuracy 0.0002in. 415/3/50 A.C.
PFEIFER Precision Toolroom Lathe. Model P.12, 9in. centres by 44in. between, 1,000 r.p.m. Norton feed box, 187 threads Whitworth, metric and module, turning accuracy 0.002mm., 415/3/50 A.C.
TROGLIA Lathe. Model TPM20. 10½in. centres by 76in. between 31in. in gap, 850 r.p.m., Norton feed box. Whitworth, metric and module. 415/3/50 A.C.
GRANVILLE SENIOR 3½in./4in. H.D. Bench Centre Lathe, 21in. b.c. Motorised.
ASTRA 6in. Stroke Slotting Machine, 4 speeds to ram, compound table. Mot. 415/3/50.
SENIOR M.1 Horizontal Milling Machines. Table 25in. by 6½in. W/S. longt. power feed, spindle speeds 12, 50/1,650 r.p.m., coolant pump. Motorised 415/3/50.
P.T.V. Universal Mill. Model 51. Table 33½in. by 8½in., power feed, 60/1,200. Dividing heads, etc. 415/3/50.
P.T.V. Vertical Mill. Model IV. Table 39in. by 8½in., power feed all directions, swivel head, rise and fall, speeds 60/1,400, dial change. 415/3/50.
ASTRA Vertical Mill. Table 23in. by 8in., hand feeds to table in all directions. No. 8 Morse spindle. Motorised 415/3/50.
FIVE STAR Tool and Cutter Grinder, capacity 5in. by 12½in., with motorised workhead for external and internal grinding. 415/3/50.

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WILLIAM URQUHART
1023-1027 Garratt Lane, London, S.W.17
'Phone: WIMbledon 6341

HEALD No. 45 Single-end Borematic. Complete with 4-Heald Style 14-16A heads, 1940.
CINCINNATI 5/60 Hydromatic 60in. Traverse to Table speeds 17 to 127. 15 h.p. 400/3/50, 1941.
KEARNS No. 2 Patent Horizontal Borer, 3in. spindle, 30in. facing speeds 3.1/246. Screwcutting. 1942.
CHURCHILL Model OSV Vertical Spindle Surface Grinder. Capacity 40in. × 10in. Hydraulic. 1942.

BOX Z592, MACHINERY,
Clifton House, Euston Road, N.W.1.

Bench Type Spot Welder up to 5 kVA, with Thyrator Contactor and four-way heat control, £175. Suitable for fine wire assemblies, etc.—BOX Z589, MACHINERY, Clifton House, Euston Road, N.W.1.

Milling Machines. Milwaukee No. 4K. Vertical Mill. High speed series. Table 80in. × 16in. Longitudinal stroke 42in. 27 spindle speeds 12 to 1,200 r.p.m. 27 feeds $\frac{1}{16}$in. to 15in. per min. Quick traverse all directions. Dial type gear change. Power feeds to vert. head. Built-in coolant system. Fully motorised 15 h.p. 400-440/3/50. Push button starters. In new condition.—BOX Z584, MACHINERY, Clifton House, Euston Road, N.W.1.

Asquith U.G.D. Type Vertical Drill, compound table, 400/3/50.—BOX Z598, MACHINERY, Clifton House, Euston Road, N.W.1.

Webster & Bennett Type 3DH 36in. Hydraulic Vertical Boring Mill, fully motorised; table speeds 9/200 r.p.m. Built 1954.

Webster & Bennett type D—36in Vertical Boring Mill with Murray control, fully motorised table speeds 8.6/192 r.p.m.—built 1947.

Kitchen & Wade type H5 Horizontal Drilling, Boring and Tapping machine, 2½in. spindle, cap. 2½in. drill with separate table, 5 ft. 6in. × 3ft. 6in., having remote control for rapid traverse, built 1953.

LOUIS DEMERY & SONS, LTD., 32, Hereford Street, Sheffield 1. 'Phone: 24936.

Victoria U2 Miller, Dividing head, vertical and slotting atts. Rotary table, vice, etc., almost new condition.—C.L. THOMAS, LTD., 18, Park Avenue, Solihull 1281.

AUCTIONS

By Order of Messrs. URQUHART LINDSAY & ROBERTSON ORCHAR, LTD.

BLACKNESS WORKS
DUNDEE

HENRY BUTCHER & CO.

are instructed to offer for SALE BY AUCTION in LOTS at BLACKNESS WORKS, DUNDEE, on

TUESDAY, 11th NOVEMBER, 1958, AND DAY FOLLOWING at 11 a.m. EACH DAY, the

PLANT, MACHINERY, TOOLS & EQUIPMENT

including

S.S. & S.C., CAPSTAN and TURRET LATHES by D.S.M., Herbert, Mitchell, Holbrook, Southbend, Ward, Pratt & Whitney
CYLINDRICAL, SURFACE, AND TOOL AND CUTTER GRINDERS by Cincinnati, Churchill, Excel, Lumsden and Wickman
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PRATT & WHITNEY No. 3B JIG BORER
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PUNCHING, SHEARING AND CROPPING MACHINES
GUILLOTINES; BENDING ROLLS;
POWER HAMMERS; ARC WELDING SETS;
HYDRAULIC PRESSES
OVERHEAD TRAVELLING CRANES
HORIZONTAL AND VERTICAL MILLING MACHINES
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ELECTRIC MOTORS AND FURNACES
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800 kVA TRANSFORMERS
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DRAWING OFFICE, LABORATORY, CANTEEN AND OFFICE FURNITURE AND EQUIPMENT
LORRIES; CARS; MOBILE CRANES; AUTO TRUCKS
ENGINEERS' TOOLS AND EQUIPMENT

NOTE.—The Industrial Works at Dundee will be offered for SALE BY AUCTION at THE ROYAL HOTEL, DUNDEE, on TUESDAY, 4th NOVEMBER, 1958, at 11 a.m.

Catalogues (when ready), price 6d. each, may be obtained of: Messrs. HENRY BUTCHER & CO., Auctioneers, Valuers & Surveyors of Factories, Plant & Equipment, 73, Chancery Lane, London, W.C.2. Telephone: HOLborn 8411 (8 lines).

SHOULER & SON

By Order of the E. R. Minister of Supply

Sale by Auction at
MELTON MOWBRAY
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MACHINE TOOLS; ENGINE SPARES; LIFTING EQUIPMENT; STEEL WIRE ROPE; RADAR TRAILER VANS; STORES; GRAMOPHONE RECORDERS AND CINE PROJECTORS now lying at

TECHNICAL STORES DEPOT, OLD DALBY (6 miles Melton; 12 from Nottingham; 15 from Leicester; and near Old Dalby L.M.S. Railway Station).
GENERAL STORES SUB-DEPOT, BOUGHTON, nr NEW OLLERTON, NOTTS. (8 miles from Mansfield; 16 miles Nottingham 12 miles Newark).
TECHNICAL STORES SUB-DEPOT, QUENIBOROUGH
(On main road midway Melton and Leicester), including:

17 Ward No. 7 Turret Lathes; Centre Lathes, 3½ to 8in.; Cincinnati and other Horizontal and Vertical Millers; Shapers; Paddon Reboring M/cs.; Arc Welders; Pillar and Bench Drills; Portable El. Drills, Saws, Sanders and Grinders; Pedestal, Bench and Flex-shaft Grinders; Valve Refacers and Seat Grinders; Hacksaws; Magnetic Chucks; Welding Kits; Circular Saw Bench; Saw Blades; Plane and Moulding Iron Grinders; Diamond mounted Wheel Dressers; Oxy-Acet. Pantograph Cutting M/c.; Gramophones, Projectors, and Photographic and Cine Spares; Cotton Sheeting and Blanketing; Steel Wire Rope; Lifting Jacks; Chain Pulley Blocks; Portable Runways; Wood Rollers, Beams and Skids; Slings; Truck Spares; Platform Trucks; Paint, Varnish Soft Soap, Whiting; Cartons, Bags, Packing Cases, Paint Canisters; Radar Trailer Vans.

WHICH WILL BE SOLD BY AUCTION BY

SHOULER & SON

on **WEDNESDAY AND THURSDAY, NOVEMBER 5th and 6th, 1958,** at 10.30 a.m. prompt each day AT THEIR AUCTION ASSEMBLY ROOMS, 1, NORMAN STREET, MELTON MOWBRAY.

ON VIEW: Thursday, Monday and Tuesday, October 30th and November 3rd and 4th, and on mornings of sale.

CATALOGUES, 1s. each (P.O. only, no stamps), obtainable from the Auctioneers, Dept. 12, 1 and 3, Norman Street, Melton Mowbray. Tel. 3081 (2 lines).

SITUATIONS VACANT

If you do not wish your reply to any Box No. advertisement in this section to be forwarded to certain firms, please advise us. Your reply will then be destroyed, but you will not be notified as this would disclose the identity of the advertiser.

Assembly Departmental Manager required by S.W. London Company manufacturing Electricity Meters of all types. Applicants must have had similar experience, controlling approx. 250 employees, responsible to Works Manager. Must be conversant with modern methods, time study and possess a background relating to accurate electro-mechanical instrument assembly and be able to ensure quality results against scheduled requirements. The appointment carries an attractive salary with a contributory pension scheme, good conditions, full encouragement by top management to the person selected showing initiative and obtaining the desired results. Age 35/45.—Write, with full particulars of experience, BOX 3, SMITH METERS, LTD., Rowan Road, Streatham Vale, London, S.W.16.

London Machine Tool Merchants require Salesman to deal with orders, correspondence, etc. Salary £500/700 plus commission, according to experience.—BOX Z566, MACHINERY, Clifton House, Euston Road, N.W.1.

Designer Wanted to Develop range of Hydraulic-Electric Lifting Machines, etc. Location South-West Wales.—Full details including education, qualifications experience, age, salary, to BOX Z599, MACHINERY, Clifton House, Euston Road, N.W.1.

Setter/Improver Wanted, for Swiss type automatics. N.W.10 area.—BOX Z605, MACHINERY, Clifton House, Euston Road, N.W.1.

Machine Shop Manager Re-quired by firm in the Leeds area engaged in precision forging. Applicant must be conversant with milling machines, shapers, planers, grinders, autos., etc. A knowledge of toolmaking and fitting also required. Forging and upsetting experience is an advantage, and candidate must be accustomed to the control of skilled and semi-skilled labour. In reply, please state fully past experience and range of salary required.—BOX Z501, MACHINERY, Clifton House, Euston Road, N.W.1.

Production Engineer Requires Assistant. Old-established Light Engineering Co., N.W. London District, offers excellent opportunity with interesting work for keen young Production Engineer (H.N.C. Standard preferred) with experience of tool design and production methods on the manufacture of small precision mechanisms.—Write full details of education, experience and present salary in confidence, to WORKS MANAGER, BOX "F.Y.," c/o J. W. VICKERS & CO., LTD., 7, Great Winchester Street, E.C.2.

TECHNICAL SALES—INDUSTRIAL OILS

Applications are invited for a senior position on the outside Technical Sales Staff of a well-known oil firm, specialising in products for the metal working industry. This is an important post on the Sales Director's staff and commands a substantial starting salary.
The successful applicant will be a man of wide relevant experience and outstanding ability with a keen pioneering sense. He will be expected eventually to take over Midlands area Sales Managership. Machine shop and sales experience indispensable as also is residence in the area.
Preferred age 40 to 45 years.

Apply in strict confidence to BOX Z590, MACHINERY, Clifton House, Euston Road, N.W.1.

DEVELOPMENT ENGINEER

A progressive South Yorkshire Company with Nationally recognised reputation for high quality products require the services of an Engineer of outstanding ability with a wide experience of Carbide Tool Design and Application.

Duties will include Development design projects, Investigation and Demonstration at Customers' Works with both established and experimental grades, Improving production techniques, and the Commercial application of all aspects of Tool Manufacture.

A wide engineering background based on extensive machine shop experience, coupled with a sound knowledge of Sales Techniques, is essential.

Salary offered will reflect the high level of responsibility involved.

Applications, giving full details of qualifications, experience and present salary (in confidence), to The Personnel Manager, BOX Z587, MACHINERY, Clifton House, Euston Road, N.W.1.

Working Foreman for Swiss and Turret Auto Division, with considerable practical experience of setting. Cam designing an advantage. Good rates and excellent prospects.—Apply in writing, stating full details to NEUBURGER PRODUCTS, LTD., Rushgrove Parade, N.W.9.

Highly Paid Secure and Interest-ing posts are always available for technically trained men. Find out how you can put some letters after your name by preparing at home in "No Pass—No Fee" terms for A.M.I.Mech.E., A.M.I.Prod.E., A.M.S.E., City and Guilds, etc., etc Full details of exams. and hundreds of courses in all branches of Engineering, Draughtsmanship and Management, the benefits of our Employment Dept., and unique record of 95 per cent. successes, are given in "Engineering Opportunities"—valuable 144-page Guide which will reveal many chances you are now missing. Write for your copy today (stating subject of interest) —FREE and without obligation.—B.I.E.T., Dept. 34a, Wright's Lane, London, W.8.

MACHINE SHOP MANAGER with wide and comprehensive experience of light production engineering is offered a unique opportunity to establish and develop a Production Engineering Company, by an old-established General Engineering Firm in S.E. London area, who for many years have been sub-contracting this class of work.
Workshop space (about 2,000 square feet to start), with all services, is immediately available. The successful applicant would be responsible for engaging labour and equipping the shop. The parent company has some machine tools, small tools, etc., available if desired.
Initially the appointment would entail much work "on the floor," and only those prepared to get their hands dirty need apply.—BOX Z557, MACHINERY, Clifton House, Euston Road, N.W.1.

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A SMALL ADVERTISEMENT IN "MACHINERY" BRINGS RESULTS

WIGAN AND DISTRICT MINING AND TECHNICAL COLLEGE

Applications are Invited for a post as Assistant Grade B in Mechanical Engineering. Duties will commence as soon as possible. Candidates should hold a degree in Mechanical Engineering or equivalent qualification, have practical experience in industry or teaching. Salary scale £650 × £25—£1,025 per annum with additions for qualifications and experience.

Further particulars and application form will be sent by the undersigned. Last date for receipt of applications: Friday, 7th November, 1958.

E. C. SMITH,
Principal.

October, 1958.

Classified Advertisements (SITUATIONS VACANT, contd.)

N.W. London firm manufacturing precision equipment require a planning and production engineer aged between 30 and 40. Applicant must have experience in small batch production. Only top rate men capable of holding down a four figure salary need apply.

Box Z 543, MACHINERY, Clifton House, Euston Road, N.W.1.

REPRESENTATIVES

Slip Gauge Manufacturers Wish to appoint Agent for Greater London. Must have good standing with and at present making regular calls upon buyers of precision small tools.—Write, giving full particulars, in confidence, to BOX Z540, MACHINERY, Clifton House, Euston Road, N.W.1.

Technical Representative Re-quired for Scotland by well-known established Machine Tool Company. Salary and expense allowance. Car provided. Applicants should have thorough knowledge of practical engineering.—Write stating age, experience and qualifications to BOX Z606, MACHINERY, Clifton House, Euston Road, N.W.1.

Free Lance Sales Representative required to sell Swiss machines in Northern England area to present customers and also to open new accounts. These are small precision machines and have been sold in the United Kingdom for the past thirty years. Details required—when replying—of types of products sold at the present moment, business contacts, previous experience, commission required, etc. —BOX Z607, MACHINERY, Clifton House, Euston Road, N.W.1.

Freelance Agents Required for the sale of well-introduced machine tools and workshop equipment, in all areas except Birmingham and Yorkshire. Liberal commission and mileage allowance. Workshop experience required, car owner preferred.—BOX Z445, MACHINERY Clifton House, Euston Road, N.W.1.

Agents Required for Precision gauge and toolmakers, specialising in form grinding and spline gauges.—BOX Z553, MACHINERY, Clifton House, Euston Road, N.W.1.

Barrel Finishing. Agents Re-quired in all areas for our compounds and media.—GRANATT CHEMICAL AND ENGINEERING CO., Austin Road, Battersea, London, S.W.11. MACaulay 7723.

MACHINE TOOL SALESMAN

Vacancy occurs in Well-known Machine Tool House for Junior Salesman to operate in the North Birmingham Area. Applicant must have engineering background and preference given to man with established connections. Full details in confidence.

BOX Z570, MACHINERY, Clifton House, Euston Road, N.W.1.

Experienced Machine Tool Representative for West Midland area required by renowned Company.—Full details of experience, age, salary required to BOX Z559, MACHINERY, Clifton House, Euston Road, N.W.1.

Springs. Manufacturers of High quality springs and presswork for the Aircraft, Electronic and Instrument Trades situated in the Midlands, require Representatives. The applicants must have established connections and if successful the position will be progressive, as this Company is expanding. Pension scheme. Please reply giving details of experience and present salary.—BOX Z583, MACHINERY, Clifton House, Euston Road, N.W.1.

Agent or Free Lance Technical Representative required on commission for medium sized well-established London Company of Precision Engineers and Toolmakers, to introduce work for well equipped machine shop and toolroom. A.I.D. and A.R.B. approved. Workmanship and deliveries guaranteed. Prices highly competitive. An opportunity for a first class man with live connections who can produce results. Attractive commission will be offered. All replies in strictest confidence to General Manager.—BOX Z595, MACHINERY, Clifton House, Euston Road, N.W.1.

Representative Required for Surrey, Kent and Sussex, initially to work on a free lance basis. Products include Vertical Drilling Machines, Tool Grinders and associated equipment, with a rapidly developing special machine section.—Please state products now represented, details of previous experience, etc., to BOX Z593, MACHINERY, Clifton House, Euston Road, N.W.1.

Wanted, Free Lance Representa-tives already calling on the Engineering and Plastics Industries to sell Hydraulic Presses and Hydraulic Equipment. Only experienced men with technical experience and established connections.—Write BOX Z600, MACHINERY, Clifton House, Euston Road, N.W.1.

SITUATIONS WANTED

Works Manager, 38, Seeks Pro-gressive post, 22 years' experience all departments light precision engineering, including toolroom, drawing office, sales, buying, estimating and production. Present position responsible for running company manufacturing press tools, jigs, fixtures and moulds to the trade, also precision parts. Would consider position as technical representative.—BOX Z533, MACHINERY, Clifton House, Euston Road, N.W.1.

Engineer, 40, Over 20 Years extensive experience in light engineering including automatics, capstans, etc. Seeks change in responsible position.—BOX Z585, MACHINERY, Clifton House, Euston Road, N.W.1.

Senior Machine Tool Correspon-dent many years experience Sales Department and Showroom control seeks position of responsibility.—BOX Z575, MACHINERY, Clifton House, Euston Road, N.W.1.

Senior Estimator/Planner with practical tool design and workshop experience, light/medium engineering, seeks post preferably South Coast area. Would accept responsibility as Works Manager with small progressive firm.—BOX Z574, MACHINERY, Clifton House, Euston Road, N.W.1.

Method Planning Development Engineer and Automatic Cam Designer (34), apprenticeship trained with technical background. Experienced in production engineering and applied automation, desires position in South Wales.—BOX Z602, MACHINERY, Clifton House, Euston Road, N.W.1.

Mechanical Designer. Experi-enced in special purpose machines, general tooling, industrial gas turbines, aero engines, automotive design, etc. Formerly Chief Draughtsman, recently returned from U.S.A. Desires position in machine design.—BOX Z442, MACHINERY, Clifton House, Euston Road, N.W.1.

Advertiser, Age 34 Years, Very wide experience of all aspects of new and secondhand machine tool merchanting, including management, inspection, valuation, sales, advertising, etc., etc., seeks responsible position inside or out. First class references.—BOX Z541, MACHINERY, Clifton House, Euston Road, N.W.1.

Chief Inspector, I.E.M.E., A.I.D., A.R.B. approved, desires similar position London district.—BOX Z536, MACHINERY, Clifton House, Euston Road, N.W.1.

Engineer (46), Administrative grade, seeks supervisory position. Indentured apprentice. Positions held: Production Shop Foreman, Toolroom Foreman, Planning and Methods. Production Development Engineer. Present salary £1,025. (Own mobile home.)—BOX Z349, MACHINERY, Clifton House, Euston Road, N.W.1.

Chief Engineer Works Manager. 47. A.M.I.P.E. desires change. Extensive experience of factory automation and batch production for precision mechanical, electrical, pneumatic equipment. Introduction of new products covering design, development and productionising, patents, etc.—BOX Z610 MACHINERY, Clifton House, Euston Road, N.W.1.

REPRESENTATIVES

Traveller, With Many Years' experience, selling capacity for Automatics, Capstans and C/H Machines. Area covered Northern, Midlands, London and Southern Counties.—BOX Z490, MACHINERY, Clifton House, Euston Road, N.W.1.

Press Tools, Jigs, Fixtures: advertiser nationwide connection wishes to represent first class company, part expense allowance and commission.—BOX Z565, MACHINERY, Clifton House, Euston Road, N.W.1.

RECEIVED TOO LATE FOR CLASSIFICATION

PLANT WANTED

One Secondhand Corona 16MX 12 spindle adjustable shoe drilling machine. —BOX Z603, MACHINERY, Clifton House, Euston Road, N.W.1.

INDEX TO ADVERTISERS

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INDEX TO ADVERTISERS—*(continued from page 177)*


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